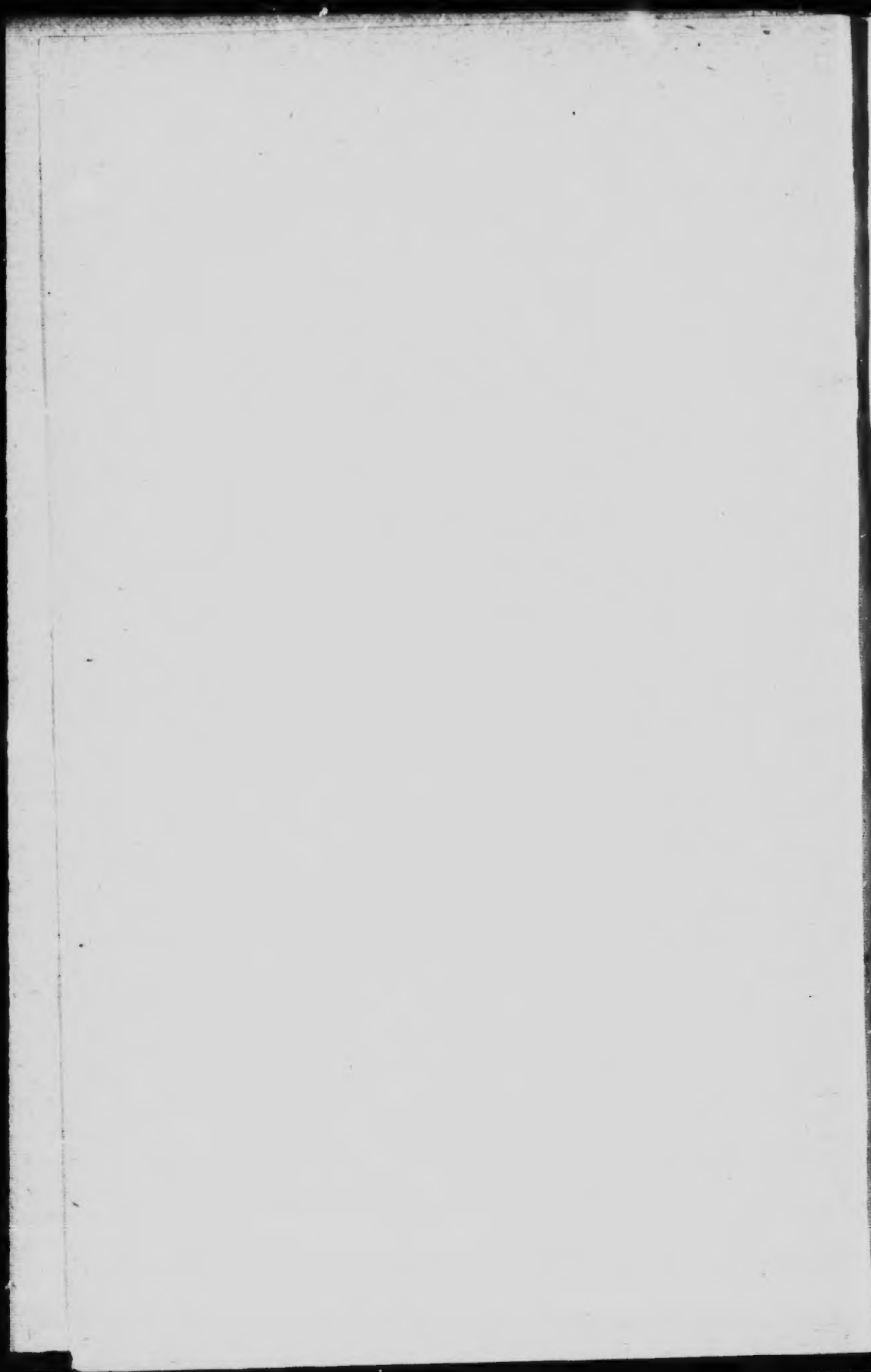
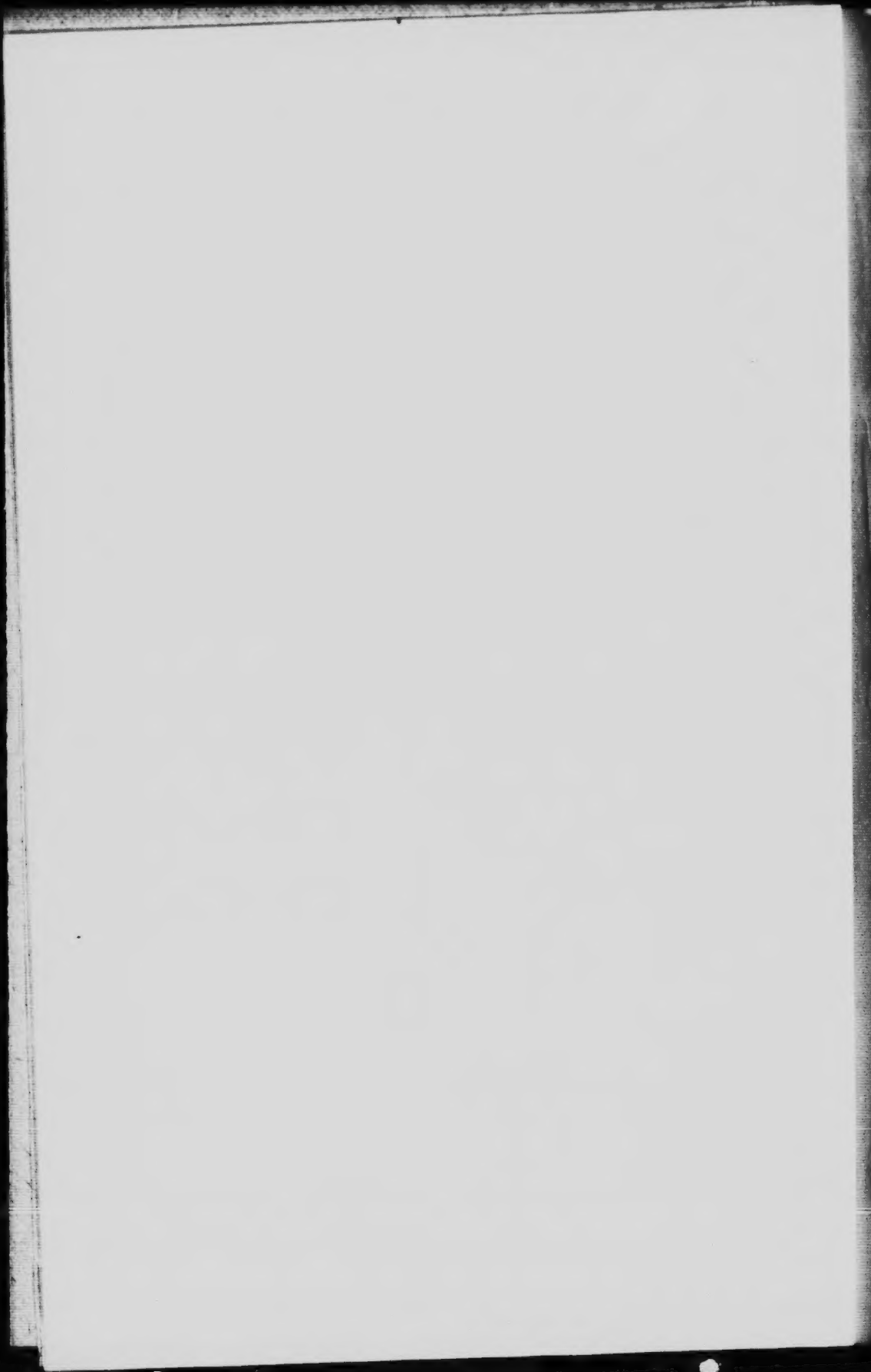




A TEXT BOOK OF OPHTHALMIC
OPERATIONS



A TEXT-BOOK
OF
OPHTHALMIC OPERATIONS

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PREFACE TO SECOND EDITION

IN offering a second edition of the text-book we have not found it necessary to deviate much from the lines that we originally laid down. Our object was, and is, to give the student, in outline, the chief ways in which the various problems have been attacked, and to leave him to adapt some one of them to his varying requirements. When we produced the first edition no book had appeared in English on operative ophthalmic surgery for half a century. It was inevitable that the choice of operations which we made would not appeal to everyone, and we were more concerned in the classification than in the examples chosen to illustrate it. Yet we have been gratified to find that in books which have appeared since our choice has been upheld and the method of classification which we originated has been largely followed.

It would be easy to multiply varieties of any operation, but this would swell the bulk of the book beyond our intention, and we have, in this edition, excised descriptions of various procedures which appeared in the first edition, and now seem to us unnecessary to our plan.

We have retained the order of the chapters almost unchanged; it was originally based on the order in which we have found it convenient to proceed when teaching the subject to students at the Royal Westminster Ophthalmic Hospital.

For economy of material those operations were undertaken first which would interfere least with the performance of others subsequently on the same subject. But we have compiled a chapter on operations on the conjunctiva, and added one on the treatment of retained foreign bodies.

The progress of ophthalmology has made it necessary to rewrite the chapter on glaucoma.

We have been, in both editions, greatly indebted to Mr. F. Grimsdale for the illustrations, which, by our desire, he has made largely diagrammatic. In this way, and in no other, is it possible to accentuate properly the important points of the operations. Photographic reproductions of the scene of actual operation seem to us rarely of any value.

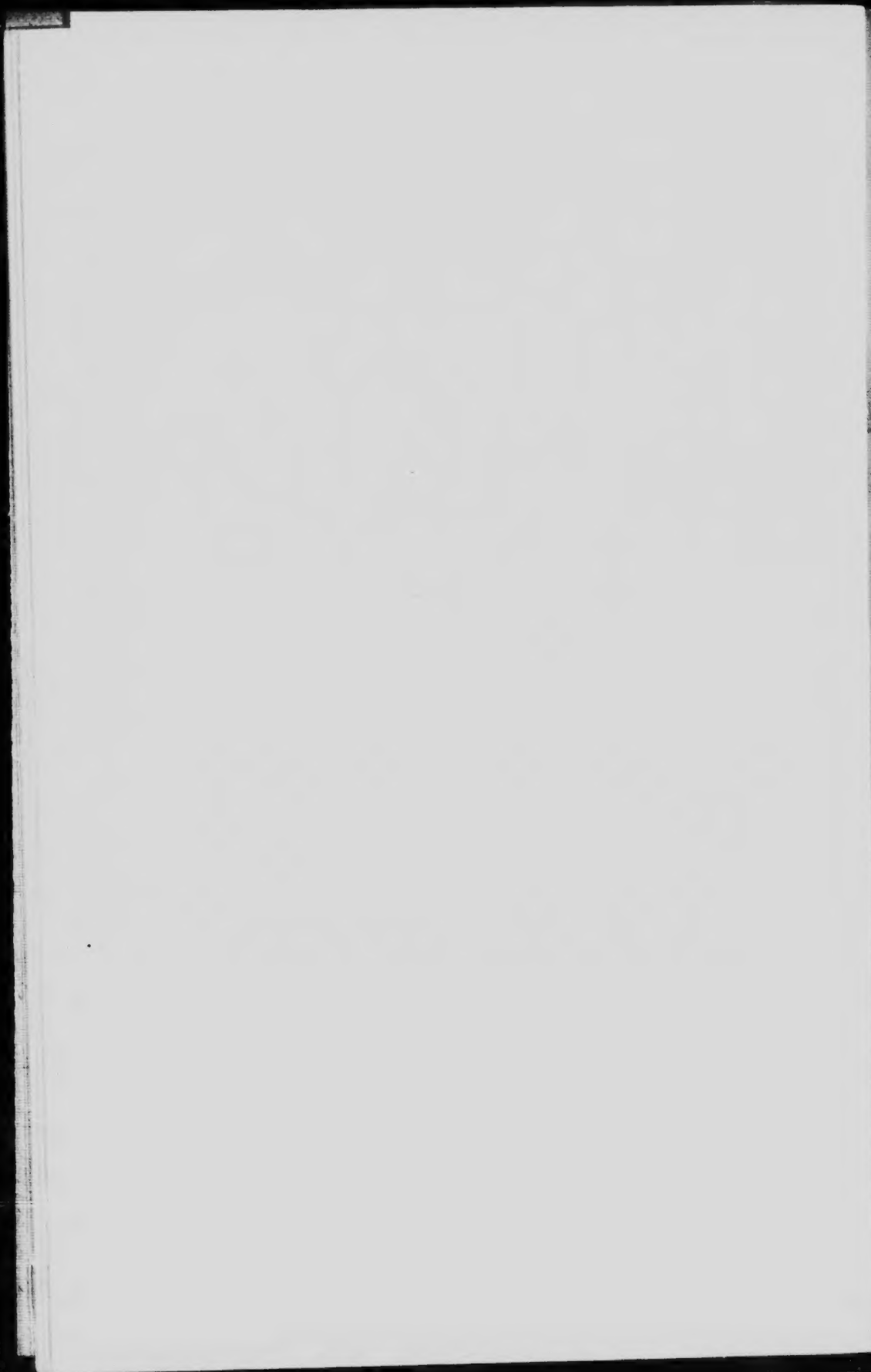
H. G.

E. B.

LONDON,
January, 1920.

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A Text-Book of Ophthalmic Operations

CHAPTER I

OPERATIONS ON MUSCLES

OPERATIONS on the extrinsic muscles of the eye are undertaken for one of four conditions, which are, in order of frequency, as follows:—

- (1) As cosmetic operations, to remove some obvious deformity such as squint, with defective vision of the squinting eye.
- (2) As a remedial operation, to give equilibrium of the ocular muscles in cases of squint with good vision of both eyes, and in cases of heterophoria.
- (3) As compensatory measures, to make up for some loss of power of one muscle, by altering the position of attachment of one or more of its fellows.
- (4) To remove enophthalmos.

Before embarking on the subject of the various procedures, it will be necessary to give a short account of the muscles and fasciæ of this region, both with regard to their anatomy and physiology.

The four recti muscles, with which the surgeon chiefly has to deal, arise from an oval fibrous ring, which is attached to the inner edge of the optic foramen, and thence bridges across the sphenoidal fissure to be inserted into a more or less prominent

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spine on the posterior border of the great wing of the sphenoid. This fibrous ring is specially thickened above and below; these parts have received special names, and are known respectively as the ligaments of Lockwood and Zinn.

Thus, at their origin, the four muscles enclose the optic nerve within the circle of their tendons, and, diverging from one another, pass forwards, surrounding the nerve, until they reach the globe.

Here, at the level of the equator, their sheaths become continuous with the capsule of Tenon. During this, the orbital part of their course, their relations are, for the most part, simple. The parietal surface of each muscle—*i.e.* that turned towards the wall of the orbit—is covered by a thin layer of fat; in addition, the superior rectus has, overlying it, the levator palpebræ, to which it is attached by a fairly strong band: these two muscles are segments of a common sheet. The external rectus has important relations to the various nerves as they pass between its two heads into the orbit, but these are rather of anatomical than of surgical importance. It must be remembered, however, that the ciliary ganglion lies embedded in the orbital fat, between the muscle and the optic nerve, at a point about an inch from the apex of the orbit; this structure has been attacked in this position for the relief of glaucoma.

While they are in relation to the globe, the superior and inferior recti lie above the superior and inferior obliqui; the superior oblique, therefore, passes between the superior rectus and the eye.

In front of the equator the muscles converge again, and, becoming tendinous, pass forwards under Tenon's capsule to be inserted into the sclerotic at varying distances from the sclero-corneal junction. It is usually said that the tendons, by their insertions, form a spiral on the globe, the rectus internus being closest to the cornea, at a distance of about 5 mm., and the superior furthest, at a distance of about 8 mm., the inferior and externus being at 6 and 7 mm. respectively. Motais has pointed

out that this is really only very roughly accurate, since the tendon of no one of the muscles has its insertion concentric with the cornea, and the superior and inferior tendons are placed very obliquely. He has also drawn attention to the fact that the insertions are not placed symmetrically with the principal axes of the cornea: the superior rectus is implanted considerably outside the position required by symmetry, and the other muscles, although to a less degree, are also asymmetrical.

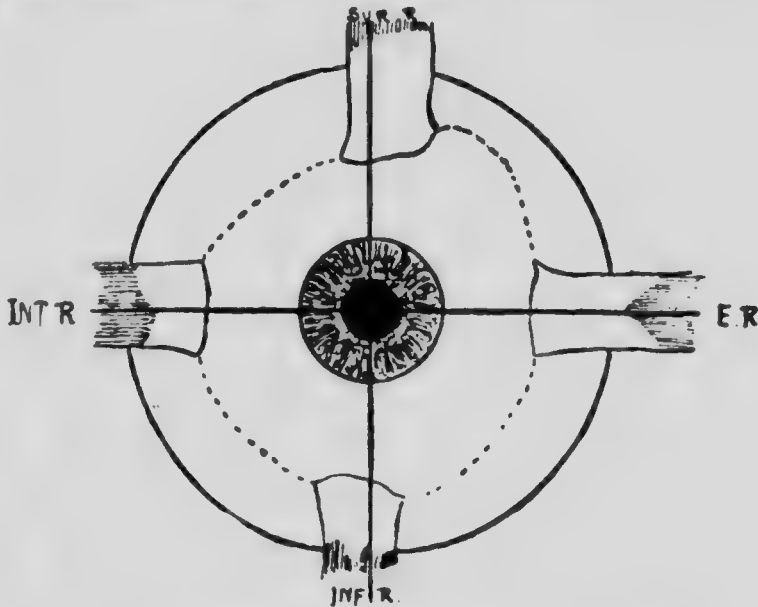


FIG. 1.—Relations of muscular insertions and Tenon's capsule.
(By permission of Dr Motais.)

Their positions are given on the accompanying diagram, which is copied from Motais. The exact positions must be borne carefully in mind during the various operations on the muscles.

The fasciæ of the anterior part of the orbit are of great surgical importance; the best description of their arrangement is that found in the work of Motais (1), to which we have already alluded. It may be summarised as follows: the fascial muscular sheaths and the connective tissue between them, on reaching the equator of the globe, spread out forwards and

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backwards over its surface, to form the capsule of Tenon. This fibrous sheet forms the anterior boundary to the inter-muscular cone of fat. In front of the equator the capsule passes forwards, under the conjunctiva and over the tendons of the recti, to blend near the margin of the cornea with the episcleral and subconjunctival tissues; into this blended mass the tendons of the recti send prolongations.

Just behind the equator a fascial sheet splits off the external muscular sheaths, to form the "funnel" (entonnoir), which, being attached all round the bony ring of the orbital margin, closes in this cavity anteriorly; certain parts of this are specially thick, and are known as the elastic ligaments of the muscles.

The lateral bands are the strongest and best marked—the inner attached to the caruncle and superior maxilla and the outer to the malar bone.

The older writers on ophthalmology, describing the physiology of the ocular movements, compared the globe in its capsule to a ball-and-socket joint; modern authors, and specially among them Motais, have pointed out that the comparison is misleading, because the capsule of Tenon, and the subjacent fat, share to some extent in the movements of the globe. By direct observation Motais has proved that when, for example, the internal rectus by its contraction rotates the posterior pole of the eye outwards, the capsule of Tenon and the fat move outwards also, though to a less degree than the globe itself. Further, he has pointed out that if the capsule were fixed and really formed a socket, the optic nerve would, of necessity, move up and down in its sheath like a piston in a cylinder. Such movement would be likely to interfere with the delicate nervous mechanism, and certainly does not take place.

In many animals—*e.g.* ruminants, who have free movement of their eyes—the space of Tenon is hardly at all developed. A large muscular mass, the choanal muscle, is inserted into the posterior part of the sclerotic directly: here there is no space of Tenon, yet movements are unimpeded. The choanal muscle and the adjacent fat must, in these circumstances, move with the globe.

It is clear, then, that the comparison to a diarthrodial joint cannot bear close examination, yet for convenience it may be retained, for it seems certain that the movements of the globe are rotations about a centre which remains practically fixed; and, indeed, it may be regarded as an axiom that the axes, round which the several pairs of muscles rotate the eye, pass through the fixed central point.

The chief factor in maintaining the fixity of the ocular centre is the vascular orbital fat: if this be much diminished the globe sinks back into the orbit, the condition known as enophthalmos; if the vessels be over-full, the eye becomes prominent. This vascular engorgement is the chief cause of the prominence in arterio-venous aneurism: occasionally we may meet with patients in whom the eyes are alternately sunken and protruding, as the orbital vessels are empty or full.

One other point seems to throw light on the importance of the fat as the chief factor in maintaining the equilibrium of the eye: all the extrinsic ocular muscles tend to pull the globe towards the inner wall of the orbit. This can easily be seen from any diagram, which will show that the resultant of the forces of the recti and obliqui must be a force acting towards the inner wall. As a matter of fact, the globe does not undergo any such transportation as would seem required by this mechanism; the only resisting structure is the fat.

The muscles, though they no doubt play an important part in preserving the equilibrium, are not essential; they may be completely paralysed without giving rise to any misplacement of the globe. The elastic ligaments and the other fascial structures which we have already described assist to a varying extent.

We may, then, for convenience regard the fat as forming a cup in which the globe plays.

The axis of rotation of any pair of muscles may be described as a line lying either in the vertical or horizontal plane, passing through the centre of the eye at right angles to the muscles in question. Thus in the case of the lateral recti, the axis of

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rotation is a vertical line through the centre of the globe, and all movements of the eye due to these muscles alone take place round this imaginary axis. In the case of the other pairs of muscles the arrangement is not so simple; since the long axis of the superior and inferior recti is not parallel to the sagittal plane of the body, but oblique, their axis of rotation is not at right angles to the visual axis, but forms an angle of about 63° with this. Hence the action of these muscles does not rotate the cornea in a vertical line.

The movements of upward and downward rotation are effected by the combined action of the superior or inferior rectus and the inferior or superior oblique muscles respectively. If we consider the movement of the cornea when the superior and inferior recti are thrown into action, it will be seen that each point of the cornea describes a segment of a circle round the axis of rotation; if the superior rectus acts, the cornea moves upwards, inwards, and the vertical axis becomes oblique, so that it is directed downwards and outwards. These movements are most easily understood if a rough model be made, as recommended by Landolt (2).

Take an india-rubber ball, about two inches in diameter; choose any point on its surface, and draw through this point two lines round the globe at right angles; these will serve to represent the horizontal and vertical planes of the eye. With a pair of compasses draw a circle whose centre is the point first selected and whose radius is half an inch; this forms the cornea: a smaller circle drawn concentrically within this will represent the pupil. The vertical axis of rotation may be easily found by taking the middle of the upper and lower vertical semicircles. A steel knitting needle driven through punctures at these points will enable us to show the movements given to the eye by the lateral recti.

The axis of rotation of the vertical recti lies in the horizontal plane at an angle of 63° from the antero-posterior axis. To demonstrate this, we must find a point on the horizontal circumference 1.1 inch from the centre of the cornea, and mark

the opposite extremity of the same diameter 1·1 inch from the posterior pole of the eye; a second knitting needle passed between these points will allow rotation of the globe round the "axis of the vertical recti," and will show the movements of the cornea.

The axis of the obliques lies also in the horizontal plane, and forms an angle with the sagittal axis of 39° ; therefore its anterior extremity must be at a point on the horizontal circumference of the globe 0·68 inch from the centre of "cornea" in our model.

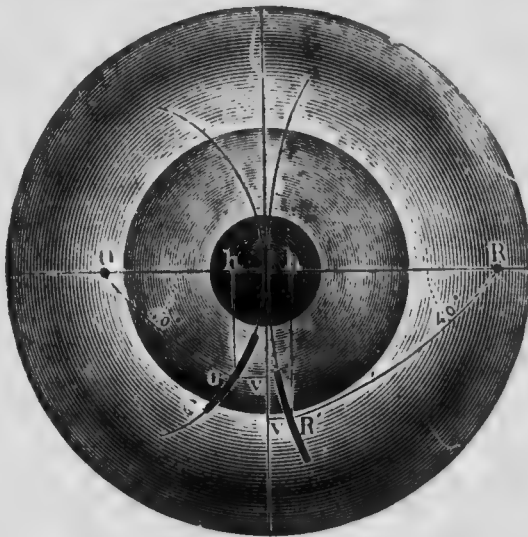


FIG. 2.—Model to show movement of cornea produced by the action of single muscles. (By permission of Prof. Landolt.)

When the eye is rotated by any one of the muscles, the movement of the centre (or any other point) of the cornea describes an arc of a circle whose centre is at the axis of rotation. If, for example, we wish to represent the movement of the corneal centre under the influence of the obliques, we must draw on the ball a circle, by means of a pair of compasses having the fixed leg at the extremity of the "oblique" axis, O, and the other at the centre of the cornea. The superior oblique will effect any movement *below* the horizontal meridian, the inferior, all movement *above* the horizontal meridian.

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If we wish to find the position of the cornea when the muscle has rotated the eye 40° , we must draw on the ball a line OO' making the angle ROO' equal to 40° and cutting the circle at O' ; then the point O' will show the position of the centre of the cornea, and a line drawn through this point at right angles to OO' will show the position of the vertical diameter of the cornea.

Similarly, if we wish to demonstrate the movement of the corneal centre, when acted on by the vertical recti, we must draw a circle having the centre R and the radius equal to the distance between this point and the centre of the cornea. By a rotation of 40° the centre of the cornea moves to R' . Since the radius of the latter circle RR' is greater than OO' , the radius of the former, the movement of the cornea for a given angular rotation is greater for the recti than for the obliques; in either case, as the diagram shows, the centre moves not only from the horizontal, but also away from the vertical meridian; by letting fall perpendiculars, $O'v$, $O'h$, and $R'v$, $R'h$, from the points O' , R' , respectively, to the vertical and horizontal meridia, we can measure directly the amount of motion in each sense.

These remarks make clear the difficulty of treating vertical displacements, since there are two muscles concerned in every vertical movement, and one only can be dealt with.

We shall now pass on to the consideration of the special cases.

SQUINT

Concomitant squint, for our immediate purpose, may be defined as a permanent want of parallelism of the visual axes, without any loss of muscular power. To whatever cause due, it eventually leads to contracture of one muscle and stretching of its opponent. In early stages it disappears under general anæsthesia; when contracture has set in, however, the change in position, even with complete muscular relaxation, is not sufficient to effect complete correction.

The deviating eye is usually very defective as regards vision,

and, therefore, any operation which is undertaken for the correction of squint must, in the large majority of cases, be simply cosmetic.

Since a squint sometimes disappears spontaneously even during adult life, no operation should be undertaken until it is fairly certain that the defect is likely to be permanent.

For surgical purposes the division of concomitant squint into convergent and divergent is important, since their treatment differs in many respects; we shall deal first of all with convergent strabismus.

Interference with the contracted muscle is the leading feature of the earlier plans of operation for strabismus. The methods fall into several minor groups, of which the following is a tabulated arrangement:—

GROUP 1.—Division of the muscle or tendon and overlying conjunctiva.

- (a) Division of the muscle itself.
- (b) Division of the tendon.
- (c) Parasccleral tenotomy.

GROUP 2.—Subconjunctival tenotomy.

- (a) Using the squint hook.
- (b) Without the squint hook.

GROUP 3.—Tenotomy with reattachment.

GROUP 4.—Multiple partial tenotomy.

GROUP 5.—Lengthening without division of the muscle.

- (a) By stretching.
- (b) By division of the fascial attachments.

In the treatment of convergent squint, the operation of tenotomy was the earliest method, and is still that most commonly employed for the correction of the deformity. Even this operation is of comparatively recent date. It would seem an obvious surgical expedient to attempt to relieve the contracture of the muscle by division, yet it was only about 1839 that this was done first. It is true that it has been claimed for the Chevalier Taylor (a skilful but somewhat irregular practitioner of the eighteenth century) that he cured squint

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by this operation, but there seems little doubt that this claim cannot be substantiated; the honour of the first operation for strabismus, then, rests with Dieffenbach (3). The suggestion was made by White about 1827, but forgotten, and revived by Strohmeier in 1838.

GROUP 1 (*a*)—Division of the muscle through a free incision. This, the original method of Dieffenbach, is only of historical interest. The muscle was exposed freely and the muscular belly divided. The operation failed in two respects: in the first place, the two parts often refused to unite, and the power of the muscle was lost; in the second, the operation opened very freely the cellular tissue of the orbit, and exposed the patient to the risk of orbital cellulitis. It, therefore, was falling into disrepute when von Graefe proposed division of the tendon. Dieffenbach soon recognised the value of this suggestion; even in 1842 he speaks of "division of the muscle or the tendon."

Von Graefe (4) drew the tendon out of the wound and divided it; the traction seriously disturbed the fascial connections.

It was in the attempt to preserve the normal relations between the muscle (including the tendon) and the fascia that Critchett devised his method of subconjunctival tenotomy. In this method a small wound is made at the border of the tendon, the squint hook is passed in under the tendon, and this is lifted away from the globe. Then the scissors are passed through the wound and the tendon divided, without any great damage to the fasciæ, and practically none to the conjunctiva. It was difficult to estimate exactly the result of this procedure, which, further, was often followed by retraction of the caruncle from the tension of the elastic ligaments when the internal rectus muscle was divided. To relieve this deformity, Koster suggested that careful dissection of the conjunctiva towards the canthus would allow the muscle to retract after division while keeping the caruncle normally prominent. His operation (*q.v.*) lays great stress on this point; but in separating

the elastic ligaments, we cause the patient to run an increased risk, that the muscle will lose all attachment to the globe. Delamare has recently gone back to a procedure allied to that of Dieffenbach, thinking that the tenotomy of the usual kind often fails to effect the readjustment of squints of large angle. He therefore divides the tendon at some little distance from its insertion, approaching the muscular fibres as he desires a greater effect, and keeping close to the sclerotic for a lesser. This he calls *parascleral tenotomy*.

Some surgeons have blamed the squint hook for the occasional divergence following the division of the tendon, thinking that it is due to the disturbance of the fasciae during the passage of the hook; hence Koster and others strongly advise that the hook should be abandoned in these procedures. It does not seem likely that a single introduction of a smooth hook could greatly disarrange the fascia; and, on the other hand, subconjunctival tenotomy in the usual mode is quite impossible without a hook: if he wish to dispense with this, the surgeon must divide the conjunctiva to some extent directly over the insertion.

All these procedures which we have been mentioning essentially consist of free division of the contracted muscle, which is allowed to retract at its own pleasure: it may or may not regain a useful attachment to the globe.

The absence of muscular tension will permit the globe to protrude, immediately after the operation, pressed forward by the orbital fat; the new insertion, if it is made, will be situated far back on the sclerotic, and in this way the action of the muscle will be seriously limited. The retraction being lessened by the elastic ligaments, it is most inadvisable to interfere with these largely, as is often done in such operations as Koster's.

The student sees at once that the action of the ocular muscles is kept steady and equal, because, so long as their insertion is in front of the transverse plane of the body, their lever of rotation is the radius of the globe. Since this is always equal, their power is also equal. But if their insertion falls behind

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the transverse plane, the length of the lever becomes less and less, and the power of the muscle is no longer exerted equally.

If, by some such operation as we have been considering, the insertion is set back a long way, it may never be in front of the transverse plane, and as the globe rotates, it will steadily diminish the mechanical advantage. For these and other reasons, the operation of simple tenotomy is not so commonly performed now as it was in former time: surgeons have tried to rid it of its inherent defects in different ways. Some, as Sydney Stephenson, lengthen the tendon by oblique division and reattachment, or supply an artificial tendon of silk: this method is free from many of the objections which were urged against simple tenotomy. It allows accurate adjustment of the deformity, and ensures the reattachment of the muscle.

Verhoeff lengthens the tendon by multiple partial division: this would seem to be a difficult operation, and in no way superior to that of Stephenson. Others advise stretching of the fascial connections without division. These last methods are little used.

The final result after a tenotomy is seldom that which is seen at the time of operation. Either the squint recurs as the new attachments strengthen, or if the muscle have been entirely separated from the sclerotic, the opponent pulls the globe further and further round.

By one of these operations of tenotomy it is possible to correct a deviation of some 18° or 20° when we are dealing with convergence (or 35° to 40° if both eyes are attacked). When we require to correct any other form of deviation, the effect of a tenotomy is much less. This will be again alluded to below.

TABLE OF OPERATIONS ON THE CONTRACTED MUSCLE.

GROUP 1.—Division of the muscle or tendon, with the conjunctiva and fascia overlying.

- (a) Division of the muscular belly (Dieffenbach).
- (b) Division of the tendon (von Graefe, Mules).
- (c) Parascleral tenotomy (Delamare).

GROUP 2.—Subconjunctival tenotomy.

- (a) Method with squint hook (Critchett, Bell Taylor).
- (b) Method without hook (Koster); graduated tenotomy (Stevens).

GROUP 3.—Tenotomy with reattachment.

Method of Stephenson, Landolt.

GROUP 4.—Multiple partial tenotomy.

Method of Verhoeff.

GROUP 5.—Lengthening without division of the muscle.

- (a) Stretching the muscle (method of Carmalt).
- (b) Division of the capsular attachments (Pari aud, Motais).

GROUP 1 (b).—Some surgeons are accustomed to make the preliminary incision through the conjunctiva, over the insertion of the muscle. This method was introduced by von Graefe.

Von Graefe's Operation (4)

Instruments.—Speculum, fixation forceps, scissors, squint hook.

First Stage.—The surgeon picks up in the forceps a fold of conjunctiva horizontally over the insertion of the muscle, and divides it with the scissors, thus making a vertical wound close to the cornea. This incision goes through the fascia as well as through the conjunctiva.

Second Stage.—Into this wound he passes the squint hook, and, lifting up the tendon on it, draws it out of the wound.

Third Stage.—He divides the tendon with the scissors.

A slight modification of this procedure was suggested by Mules, and recommended for its rapidity.

Mules' Operation (5)

The same instruments are required.

First Stage.—The surgeon picks up a horizontal fold of conjunctiva over the centre of the insertion of the muscle and thrusts the points of a pair of scissors into the lower side of it, penetrating

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the lower layer of the conjunctiva; the points are then separated, so that a funnel-shaped space is made under the conjunctiva, over the upper part of the tendon, having only a small opening at the point of insertion of the scissors.

Second Stage.—Into this space is passed the squint hook until its point reaches the upper border of the tendon. Then by a twist it is brought under the tendon.

Third Stage.—One blade of the scissors is passed, alongside of the hook, under the tendon, and all the structures between the blades are divided at one cut.

GROUP 1 (c).—Delamare (6) has recently proposed a method which may be considered a reversion towards Dieffenbach's operation.

He points out that tenotomy of the usual kind often fails to effect the readjustment of squints of large angle, and that Dieffenbach's operation was given up because of its excessive action. He thinks that by dividing the tendon at some little distance from its insertion into the sclerotic we may obtain an effect intermediate between the two. He calls his procedure PARASCLERAL TENOTOMY.

Delamare's Operation

The usual instruments.

First Stage.—The surgeon picks up a horizontal fold of conjunctiva over the insertion of the tendon and divides it with scissors, making a vertical wound, about 10 mm. long, about 10 mm. away from the cornea. He picks up the edge of conjunctiva in the forceps and undermines the conjunctiva, freeing the nodule from the superjacent tissues.

Second Stage.—He then passes the hook under the muscle and lifts it well away from the globe. Then placing one blade of the scissors under the tendon, he divides it about 2 or 3 mm. from the insertion.

He states that the result of this method is considerably greater than that of a tenotomy performed at the usual place;

if this be so, the increase is probably due to the free separation of the muscle from the surrounding structures, effected at the end of the first stage.

GROUP 2.—Critchett (7), in 1855, described the method of subconjunctival tenotomy which is still in common use.

Critchett's Operation of Subconjunctival Tenotomy

Instruments.—Speculum, fixation forceps, squint hook and scissors.

First Stage.—The surgeon picks up with the forceps a small vertical fold of conjunctiva over the lower part of the tendon

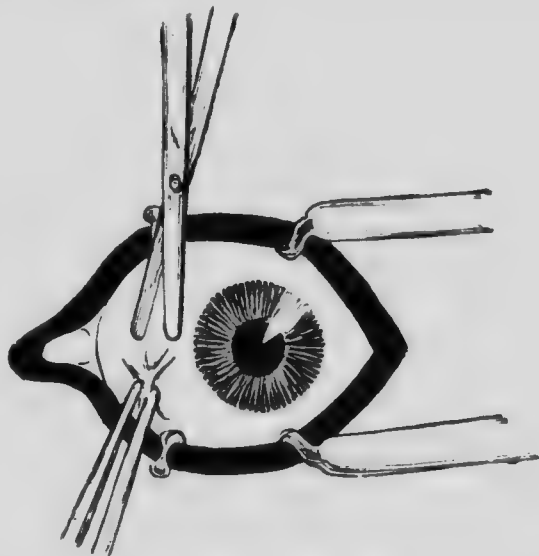


FIG. 3.—Subconjunctival tenotomy. *First stage:* division of conjunctiva.

of the muscle, and cuts through it with scissors so as to make a horizontal incision, about 5 mm. long, just below the lower border of the muscle. If the scissors are kept opening and shutting in a plane tangential to the globe, there can be no risk of wounding the sclerotic. The first cut often goes through the Tenon's capsule as well as the conjunctiva, and allows the points to sink freely into the space; if it does not, the surgeon will pick up the fascia with the forceps and divide it separately.

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Second Stage.—The hook can now be easily introduced into Tenon's space, and passed under the tendon to be divided. This is lifted away from the globe; the scissors are then passed

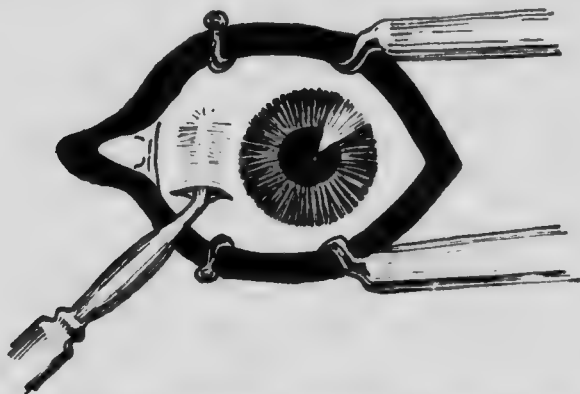


FIG. 4.—Subconjunctival tenotomy. *Second stage*: passage of squint hook.

into the wound, so that one blade is on each side of the tendon, and divide it by one or more cuts. It is usually necessary to divide several strands of fascia running to the tendon from the

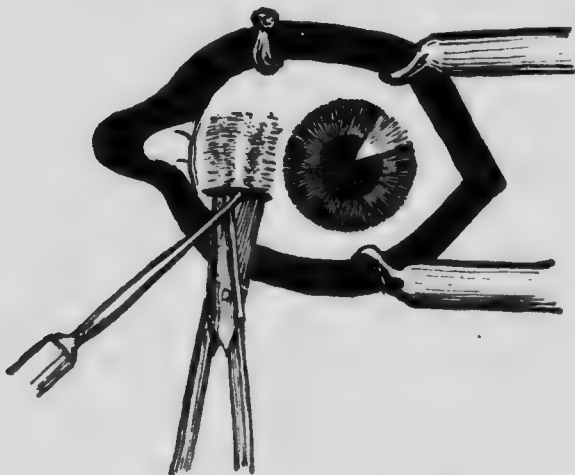


FIG. 5.—Subconjunctival tenotomy. Division of tendon with scissors.

capsule before the hook will pass the cut insertion and come forward to the sclero-corneal junction.

Critchett pointed out that if the tendon is unusually broad, the

upper strands are apt to escape from the hook; to avoid this, he advised the surgeon, when he found the tendon broad, to make a second incision above the muscle and to cut downward from this. The two incisions will, he says, allow the escape of the effused blood.

This second incision has been used by Bell Taylor (8) as a routine method: he having made the usual incision and inserted the hook in the usual way, makes the end appear prominently under the conjunctiva above the tendon and cuts down on it, from above; then he divides the tendon downwards with scissors.

GROUP 2 (b).—The primary aim of this sub-group is to avoid disturbance of the fascial connections of the muscle, by leaving out the squint hook. The tendon is picked up in forceps, and divided cautiously; the method is chiefly used by American surgeons in the treatment of heterophoria, and Stevens' method will be described in a later part of this chapter, under the heading of heterophoria.

Koster (9), however, uses the method, combined with free division of Tenon's capsule, for the surgical treatment of ordinary convergent strabismus.

Koster's Operation

Instruments.—Speculum, fixation forceps, scissors.

First Stage.—The surgeon picks up a vertical fold of conjunctiva over the tendon and divides it with the scissors, so as to make a horizontal incision over the centre of the tendon, some 6 or 7 mm. in length.

With the scissors he frees the conjunctiva round the incision from the subjacent parts, and, if operating on the rectus internus, pays special attention to the caruncle. If the bands running from the muscle sheath to this structure are detached, the subsequent retraction is reduced to a minimum.

Second Stage.—He then seizes the tendon in the fixation forceps and divides it in the centre; then, passing the scissors

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into the opening, he cuts upwards and downwards in succession, so as to divide each half of the tendon. The incisions are carried past the tendon into the capsular fascia above and below.

If an unusually large effect is required, two divergent incisions are made in the fascia from each border of the tendon after division of this. The conjunctival wound is closed by a suture.

GROUP 3.—The manifest uncertainty of the result of simple tenotomy, and the impossibility of accurate dosage, have led surgeons to seek a way of robbing it of its defects.

Sydney Stephenson's (10) Method of Lengthening Tendons

This was the first attempt at accurate adjustment, and is free from many of the disadvantages of the older operation.

The surgeon lays bare the tendon of the muscle by slight dissection, and divides it either obliquely by a single long cut, or by the method shown in the diagram (fig. 6), and then re-attaches the parts of the tendon so as to lengthen the muscle by the amount desired.

The second method may be thus described. The surgeon, having measured the linear deviation, divides the lower half of the tendon by a vertical incision close to the globe, and then, at a distance on the tendon equal to the deviation of the eye, makes a second vertical incision through the upper half; the two vertical incisions are joined by a horizontal one, and the ends adjusted so as to allow the rotation of the globe to the required extent.

This operation is a considerable advance on simple division; two points, however, occur as possible objections. In the first place, the linear measurement of the squint is not quite the same as the amount of lengthening required—and the error is greater with the increase of the squint—and, in the second, the direction of the chief action of the muscle is shifted slightly, and thus there will be a tendency towards hyperphoria.

Since, however, the operation is usually only cosmetic, this is not an important matter, and could be easily overcome by dividing the tendon into three parts and stitching the upper and lower to the middle, as in the diagram (fig. 7).

By such a method a slight amount of deviation can be

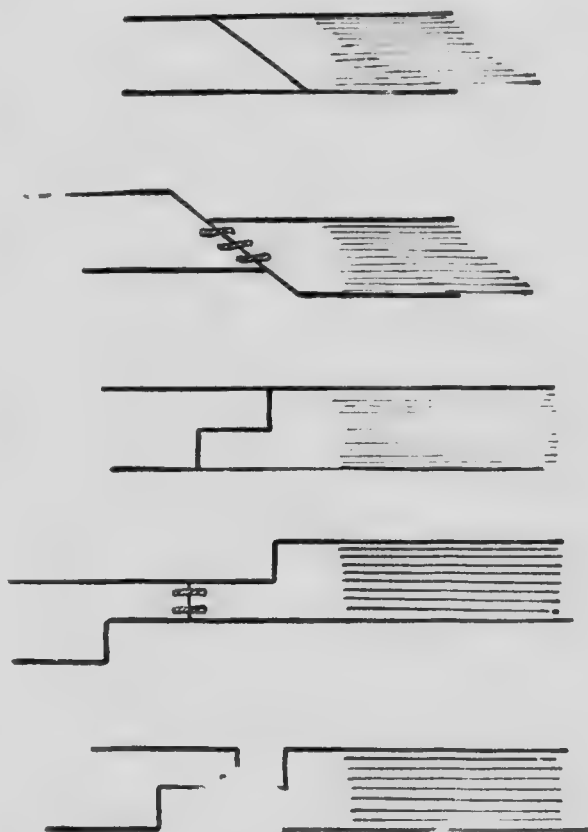


FIG. 6.—Stephenson's operation for lengthening tendons. The upper two figures show oblique divisions and re-attachment; the third and fourth, Stephenson's second method; the fifth, Landolt's method of re-attachment.

corrected with considerable accuracy, especially if the fascial connections are stretched by rotating the eye forcibly in the opposite direction with the aid of squint hook before the tendon is divided.

A tenotomy after one of these methods will correct up to

18° or 20° convergence. By operating on both eyes we may correct a total deviation of about 40°. Landolt has recently described a precisely similar procedure.

GROUP 4.—Operation of multiple partial tenotomy.

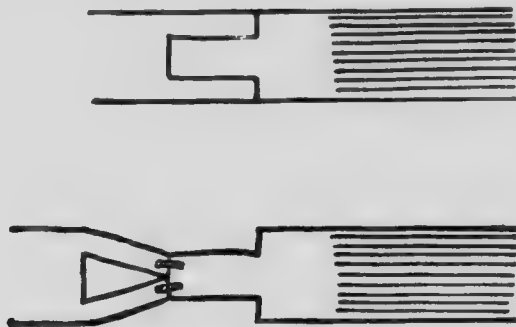


FIG. 7.—Modification of Stephenson's operation.

Verhoeff (11) lengthens the tendon without completely dividing it, as follows:—

First Stage.—The tendon is exposed with some freedom.

Second Stage.—The surgeon makes, close to each end of the

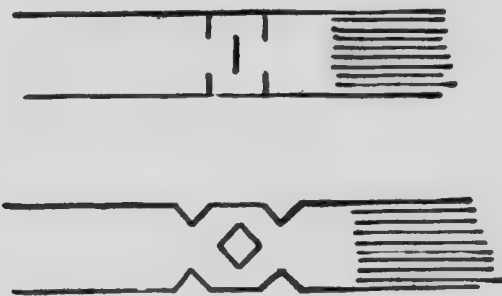


FIG. 8.—Verhoeff's Operation.

tendon, small incisions in the upper and lower borders, involving about a fifth of the breadth; midway between these pairs of incisions he makes a vertical incision extending through the two middle quarters of the tendon. In this way the whole is lengthened, without complete division.

In this procedure the final result is less than that attained at the time of operation, because the contraction draws the parts of the tendon together.

Bishop Harman (29) has slightly modified Verhoeff's incisions; he makes three incisions only—two from one border

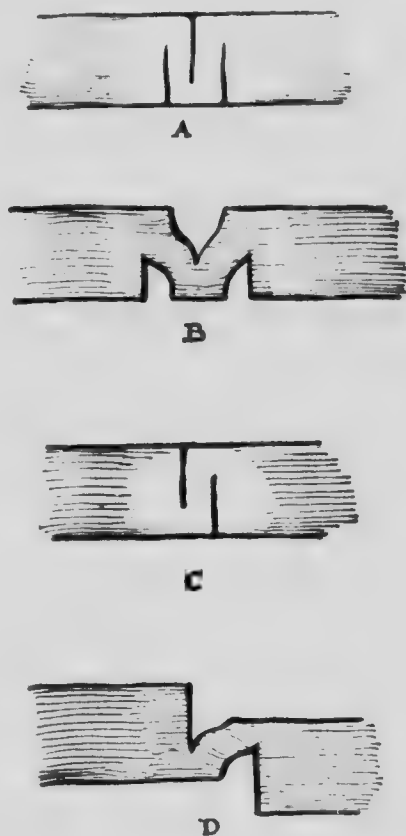


FIG. 9.—Harman's operation. A and B show lengthening from three incisions; C and D lengthening with vertical alteration from two incisions.

and one between the others from the other border. All three incisions interest some two thirds of the tendon. For simplifying the performance, Harman introduced director forceps to

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grasp the tendon; the paired incisions are made on each side of the forceps, and the medial incision on the director.

Harman points out that by making two incisions only—one from above, and one from below, the tendon—it is possible to combine lengthening with correction of vertical displacement. This is useful in those squints in which convergence is associated with upward rotation of each eye.

GROUP 5.—These methods have not been much adopted, and their value is uncertain.

Carmalt (12) narrates how he is accustomed to seize the muscle in forceps, and to rotate the eye forcibly against the muscle, stretching the latter and its fascial connections.

Fox passes a squint hook under the muscle and stretches with this; he usually excises a piece of Tenon's capsule.

Parinaud (13) advocates separation of the fascial and capsular connections as a means of correcting small deviations, and Motais (14) describes a method of dividing the alar ligaments with the same object.

In the higher degrees of convergence a tenotomy is not sufficient to correct the deformity, and even in the lesser degrees the surgeon, having regard to the disturbance which necessarily follows the uncontrolled division of a tendon, may prefer to increase the opportunity of the over-stretched muscle by advancing its insertion, instead of dividing the contracted fibres.

We have seen that in concomitant squint there is no loss of power in the muscles, but only a faulty direction of the visual axis. If we can swing the globe round within the group of muscles, so as to alter its direction without altering the relations of the muscles one to another, we shall have succeeded in removing the deformity and giving a cosmetic cure.

This is our aim in the various operations for advancement—to bring forward the insertion of one muscle and to rotate the globe so far as to correct the deviation.

In minor deviation, and especially in divergence, it has been suggested that an advancement of Tenon's capsule alone might suffice. The idea is that by excising a piece of the capsule over the stretched muscle, this may be brought forward and the direction of the visual axis altered, without any interference with the actual insertions. Webster Fox has published the results of a series of cases in which he employed this method with success.

In larger deviations the muscles must be attacked.

Critchett's operation was first devised to correct the evil following tenotomy when the muscle did not succeed in forming a new attachment, but the method was soon applied to other cases of marked squint. In the first instance, the divided muscle was sought, its anterior end refreshed and stitched again to the globe at the selected spot.

In the later cases, the muscle had to be separated from its original insertion and reapplied to the globe. In some of these cases it was found desirable to shorten the muscle by resection. When Prince's forceps are used to grasp the muscle, the bruising of the part in their grasp is considerable and resection is probably generally advisable.

Division of the tendon only, causes little disturbance of the fascial connections and relations. If the muscle itself is divided there is some fear that the reattachment will fail, and the contraction of the opponent leave the patient in worse condition than before. For this reason the suggestion was made to fold the tendon on itself, and thus shorten it, or pull it forward so that it may contract new adhesions in front of the original insertion.

The disadvantage of folding as against resection is that the folded tendon forms a thick pad, which remains red and unsightly for some time after the operation; eventually the thickening and redness disappear, but the delay is not well liked by the patient and his friends. The lessened risk to the patient has weighed with those surgeons who have adopted some form of folding.

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It will be seen that there are three forms of "advancement" operations: A true advancement of the whole insertion to some point nearer the cornea; a resection of the muscle with reattachment to the original tendon stump; and a folding of the tendon without division. There is no practical difference in the mechanical effect of all these forms of procedure, and they may be considered as one operation.

There is, however, one real difference among surgeons: some divide the opponent always, some frequently do not. If the opponent is divided, the amount of advancement is the measure of the alteration in position of the eye. If the opponent is not attacked, the advancement is partly used up in stretching the opponent, and the alteration in position of the eye is only about half the amount of advancement.

Certainly, if any large deviation is to be corrected, it is better to advance one muscle and divide the opponent. It is impossible to shorten a tendon to any large extent—if the opponent be left untouched—without increasing the pressure on the orbital contents; this will in turn throw strain on the sutures holding the tendon to its new attachment, and they will perhaps cut out too soon.

Many surgeons, in the case of small advancements, do not divide the opponent; but even in these cases it appears to us better to share the alteration in position between the two muscles.

In any advancement operation, the suturing of the tendon is one of the most doubtful points. The material used is usually silk; this must be sufficiently strong to bear a considerable strain, so that the tendon may be drawn closely to the new place of attachment, and held there firmly without fear of the suture breaking. Silk—even thin silk—is so strong that a break is rare; it is much more frequent for the fine silk to cut through the tissues in which it is placed, before the tendon is properly attached. The silk, therefore, should not be too fine, and this means that the needles must be large enough to take it.

The methods of attachment are various, but they may be divided broadly into two classes. In one the muscle is held by a single stitch, which is passed through the muscle in such a way as to gain a firm hold of it, while the ends are secured into firm tissue in front of the insertion; we have called this "attachment by a loop." The other is attachment by multiple sutures.

The advantages of the first method are rapidity and simplicity. Further, since the tension of the cord is the same throughout, all parts of the muscle held in the loop are pulled forward equally. If the ends are inserted into the episcleral tissue widely apart, the length of the loop allows the muscle to adjust itself slightly in the vertical sense. On the other hand, the muscle is apt to shrink together into a narrow band, and contract only a narrow adhesion to the globe.

In the face of these points, we may adopt some method such as Williams' with advantage when no very accurate adjustment is required—when, that is to say, a cosmetic correction only is our aim.

If we are trying to restore binocular and stereoscopic vision, it is better to choose some form of advancement with multiple sutures, so that we may reform the attachment as nearly normally as possible, and adjust accurately each part of the insertion.

When more than one suture is used, the number is usually three. The central suture fixes the central part of the tendon in the horizontal meridian of the globe; it must be passed first and tied first. The lateral sutures, passed through the lateral parts of the tendon, are made to diverge so as to spread the new attachment out on the globe.

There are two possible sites of reattachment: one school seeks to bring the cut tendon forward and fix it as near the cornea as possible; the other shortens the tendon and fixes the cut end to the stump of the old insertion. This has the advantage of allowing the surgeon a greater thickness of tissue into which to pass the suture, without fear of perfor-

ating the sclerotic. The loss of tissue involved in the resection of the tendon is not important; theoretically it might make things more awkward if the tendon did not make an attachment to the globe.

One difficulty in the use of multiple sutures is to tie them so that the tension on all is equal. Unless the central suture is tied before the lateral, it is very likely that the whole tendon will be pulled towards the suture which is tied first, and thus a condition of hyperphoria produced.

It was to avoid this danger that Valude suggested splitting the tendon and reattaching each half separately above and below the cornea.

Another difficulty is that the sutures, passed between the muscle fibres, may easily tear out if much tension is put on them, and the tendon may slip back in whole or part before the new adhesions have firmly established themselves. It is to avoid any tension on the sutures that Major O'Connor devised his method of suturing. To minimise the chance of slipping, Worth suggested that a small part of the tendon should be held by a half-knot.

Since it is difficult or impossible to judge of the permanent from the immediate result of any advancement operation, Prince and others have suggested that the sutures should not be tied firmly at first, but left in a bow-knot; they then readjust the tension on the muscle at some later time—within forty-eight hours. It does not seem wise to tear away the newly formed attachments of the tendon, as this necessarily does, and it would appear to give an increased risk of failure of union. The procedure has been recommended by some careful and distinguished surgeons, but is not likely to win general acceptance.

When passing the sutures through the substance of the sclerotic, it is difficult to gauge accurately the depth to which the needle penetrates. Experiments on the cadaver have shown that perforation is probably more frequent than is supposed; but evil results are rarely recorded. Few surgeons,

however, are likely to follow the example of Denig (30), who, to secure a firm hold for his central suture, makes the needle enter the anterior chamber.

Some surgeons, if they think that the immediate effect of an operation is insufficient, will fix the eye by means of a suture, in an exaggerated position, so as to prevent the recurrence of the deformity which usually appears during healing. This suture is often so placed as to lie straight across the cornea; but this membrane does not seem to suffer therefrom.

This fact disposes of one objection urged sometimes against Williams' operation, that the suture at the corneal margin may do damage. After a considerable experience we can say that we have never seen any hurt.

ADVANCEMENT OPERATIONS

GROUP 1.—Advancement of capsule with stretching of opponent (method of Webster Fox).

GROUP 2.—Reattachment of a divided muscle with or without resection.

(a) Attachment by multiple sutures (method of Critchett, Worth, Valude, Jocqs, Landolt).

(b) Attachment by a loop (method of Williams, Prince, Lindo Ferguson).

GROUP 3.—Folding of the muscle without division (musculo-capsular advancement) (method of De Wecker).

GROUP 1.—In minor deviations, and especially in divergence, some such procedure as that recommended by Webster Fox may be tried.

Webster Fox's Operation (15)

The instruments needed are speculum, squint hook, special broad fixation forceps, scissors, and needles.

The *First Stage* of the operation is stretching the fascial connection. The operator, standing on the same side of the eye as the muscle to be advanced, makes a small incision into

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Ienon's space, below the margin of the opponent. Under the tendon he passes a squint hook and rotates the globe forcibly, so as to overcome the existing deviation ; afterwards he divides the tendon on the hook.

The *Second Stage* consists in picking up with broad-bladed forceps the tissues over the muscle, at a point midway between the cornea and caruncle : by raising the forceps two or three times it is easy to separate the conjunctiva and subjacent tissue from the muscle. The fold thus picked up is cut off by a single sweep of the scissors, leaving an elliptical wound, at the bottom of which is seen the muscle.

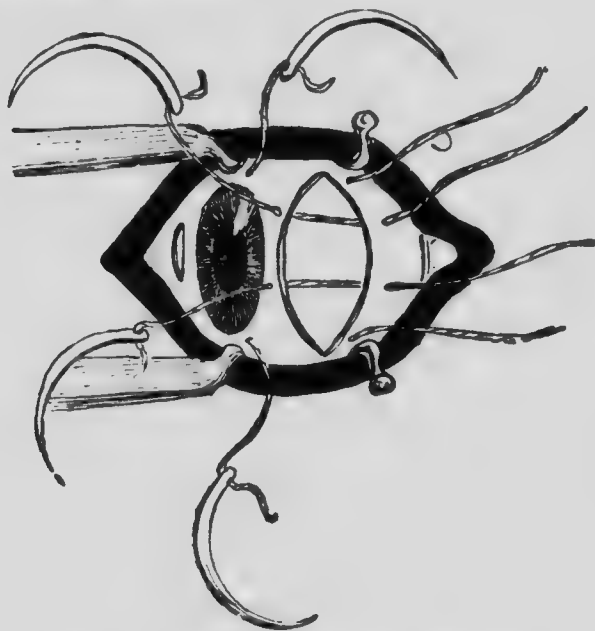


FIG. 10.—Webster Fox's operation. *Final stage.*

Lastly, three or four sutures are passed through conjunctiva and capsule on each side of the incision across the wound, which is closed when they are tied.

In most cases, however, the insertion of the muscle must be advanced, and for this several operations have been suggested.

GROUP 2 (*a*).—Attachment by multiple sutures.

Critchett's Operation (16)

Critchett's operation for advancement has undergone many modifications of little importance since it was first devised. The operation is still performed almost as its originator described.

The instruments required are speculum, fixation forceps, straight strabismus scissors, Prince's forceps, squint hook, needles and needle-holders. The needles used are best No. 20, silk No. 0.

The operation may be considered in four stages:—

First Stage.—Exposure of the Tendon.—The tendon of the muscle to be advanced is exposed by a vertical incision over it, about 5 mm. from the cornea. Under it is passed the female

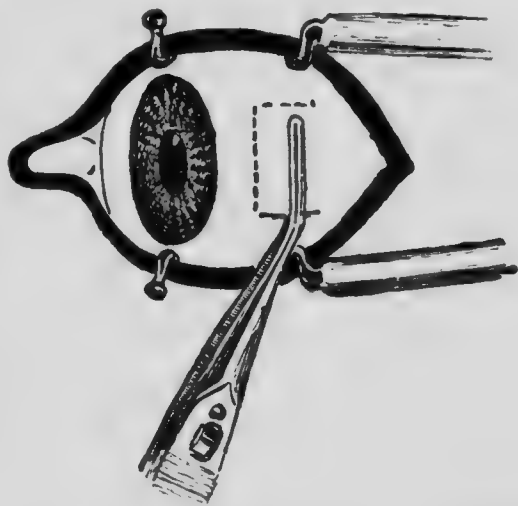


FIG. 11.—Critchett's operation—modification. The dotted lines show incisions to separate the tendon.

blade of Prince's forceps; the male blade remains on the outer surface of the conjunctiva. The tendon, capsule, and conjunctiva are all grasped firmly by closing the blades. This method interferes somewhat seriously with the fasciae; it is less disturbing to make a small incision at the border of the muscle, as in subconjunctival tenotomy, and pass the inner blade of the forceps through this, under the tendon.

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The *Second Stage* consists in separating the muscle from the globe. The tendon is divided on the ocular side of the forceps, and two small horizontal incisions are made through conjunctiva and capsule along the upper and lower edges of the muscle.

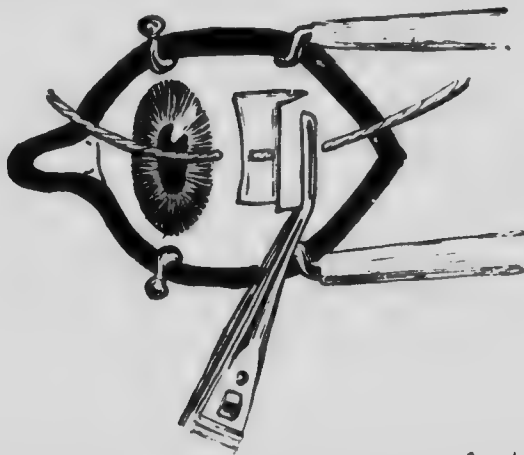


FIG. 12.—Critchett's operation. *Third stage*: passage of central suture.

Third Stage.—The Passage of the Sutures.—Three very fine needles armed with fine silk are passed through conjunctiva,

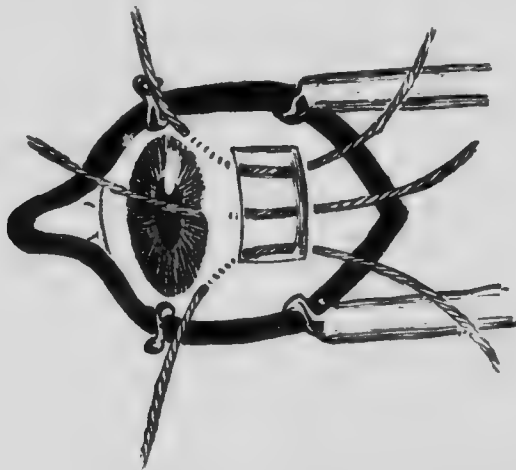


FIG. 13.—Critchett's operation. *Fourth stage*: all sutures in position, and tendon resected.

capsule, and muscle, one in the centre and one at each end of a vertical line whose position has been estimated by the

operator, and then passed under the conjunctiva to the margin of the cornea, diverging slightly and picking up a little superficial scleral tissue just before their exit.

Fourth Stage.—The portion of muscle and conjunctiva held in the forceps is cut off and the sutures tied; the horizontal one is tied first, and the muscle thus adjusted in the vertical plane before the upper and lower threads are secured. The sutures practically close the conjunctival wound.

Some surgeons make the central stitch a "mattress stitch"; they pass the needle through the conjunctiva and the muscle about 2 mm. below the centre, and then pass through the stump of the tendon and conjunctiva. They enter it again about 4 mm. away and pass it through conjunctiva and stump,

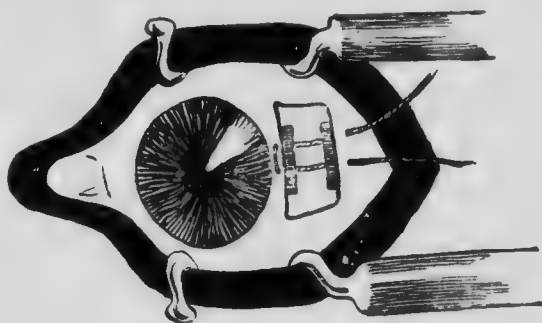


FIG. 14.—Crichtett's operation. Central mattress stitch.

leaving a loop on the surface. Finally, they pass it through the muscle from the deep surface to the superficial, so that it emerges on the conjunctiva, about 4 mm. from the point of entrance, but in the same vertical line. The ends are tied on the superficial surface.

Another good method is that of Worth, which is a slight variation of Crichtett's original operation.

Worth's Operation (17)

The instruments required and the first stages of the operation are practically the same as in the parent method.

The difference lies in the mode of suturing for the reattach-

ment. Having exposed the tendon and divided it, held in Prince's forceps as just described, we pass to the *Third Stage* of the method.

Holding the tendon away from the globe, the surgeon passes two sutures in the following way:—A small curved needle is made to pierce the conjunctiva and capsule just above the

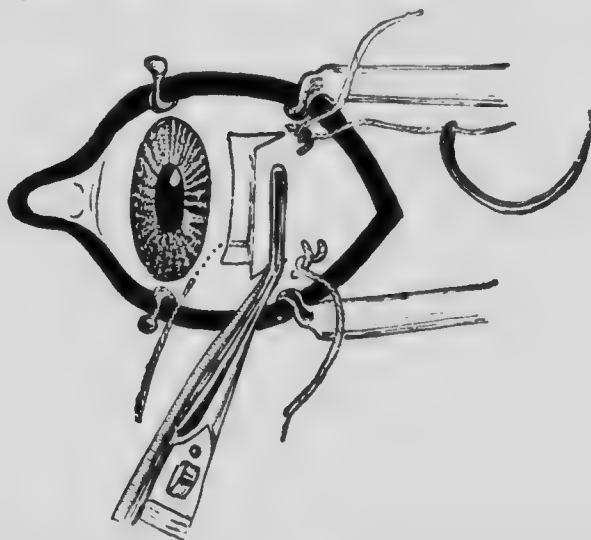


FIG. 15.—Worth's operation. *Third stage*: The passage of the lower suture is complete; the upper has passed through muscle only.

upper edge of the muscle, and is then pushed under this edge and made to traverse muscle, capsule, and conjunctiva on its way to the surface. There is now a loop of silk beneath the muscle, whose two ends emerge pretty close together on the conjunctiva. These ends are tied in a half-knot. A similar suture is passed under the lower edge of the muscle and tied in the same way; the position of these sutures will vary with the amount of squint, as described above. The portion of tissue held in the Prince's forceps is then cut away with scissors, and the needles, still carrying the sutures, are passed again through the muscle and forwards under the conjunctiva on the corneal side of the wound, picking up a little episcleral tissue before their exit close to the vertical diameter of the cornea.

When the ends of each suture are tied, the part of the muscle

held in the half-knot is dragged forward to the margin of the cornea and held there.

The disadvantages of Critchett's operation are that the hold of the sutures on the muscle is slight, and may give way, and that some conjunctiva is removed unnecessarily: this last point could be easily avoided, but it is of little importance. The central adjusting suture is of value, and it is a drawback to Worth's operation that it has been given up.

The better hold of the sutures in the latter is a real gain.

Landolt's Operation

Landolt (18) lays great stress on the importance of not disturbing the capsular relations of the muscle in the early stages of operation. The same instruments, with exception of Prince's forceps.

First Stage.—The surgeon lays bare the muscle by a U-shaped incision placed horizontally over the insertion, and dissects up the conjunctiva.

Second Stage.—He then picks up the capsule at the lower border of the muscle and makes a small horizontal incision: through this he inserts the squint hook under the tendon.

Third Stage.—He then passes two sutures through the muscle at a point varying with the degree of squint. The position of the two sutures divides the muscle into three equal parts from above downwards.

Fourth Stage.—He then divides the muscle, and if the squint is large, detaches the tendinous end from the sclerotic.

Fifth Stage.—Having raised the muscle by the sutures, to see that it is free from all attachment to the globe, he fixes the sutures to the episcleral tissue in the usual way.

Jocqs' Operation

Jocqs (19) describes an operation very similar to Critchett's, and calls it musculo-capsular advancement, though this term is usually applied only to those methods which do not involve division of the muscle.

Valude's Operation

Valude (20) points out that there is one great danger in the operations of the last class, in which the chief sutures diverge from the upper and lower border of the tendon to the upper and lower ends of the vertical meridian of the cornea. There is a risk that one or other may cut out, leaving the muscle attached by its upper or lower border only. This will give

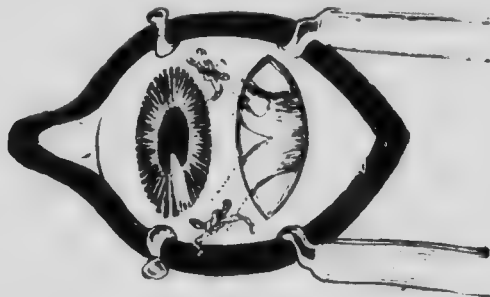


FIG. 16.—Valude's operation. The halves of the split tendon reattached separately.

rise to an abnormal rotation or cyclophoria of the globe. He therefore, for the relief of this danger, recommends the following procedure:—

First Stage.—The tendon is exposed, and two sutures are passed, one through the tendon at the junction of the upper and second quarters, the other at the junction of the lower and third quarters.

Second Stage.—The tendon is now divided from the globe, and split horizontally for some 6 or 8 millimetres.

Third Stage.—Each half is now stitched to the sclerotic near the vertical diameter of the cornea.

GROUP 2 (*b*).—Attachment by a loop.

Williams' Operation (21)

This operation, devised by Richard Williams, of Liverpool, is one of the simplest methods of advancement.

The instruments needed are: speculum, straight scissors,

fixation forceps, squint hook, needles (No. 16) fully curved, needle-holder; for the suture, silk No. 1. The operation may be considered in three stages:—

First Stage.—Exposure of the Muscle.—The surgeon, standing on the side of the muscle to be advanced, picks up a vertical

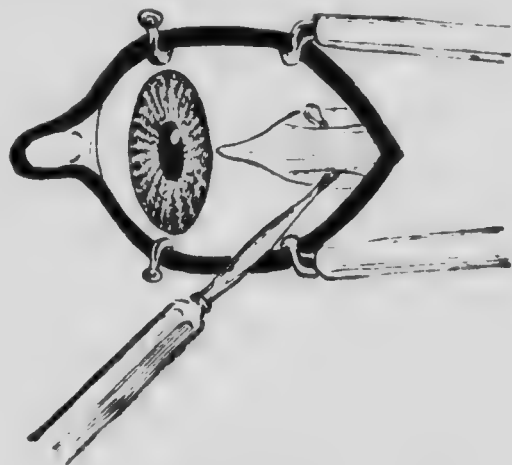


FIG. 17.—William's operation. *First stage.*

fold of conjunctiva with the fixation forceps over this muscle near its insertion, and makes with the scissors, opposite the middle of the muscle, a horizontal incision through this fold; then he enlarges the wound towards the canthus and to the edge of the cornea, laying bare the muscle by slight dissections and freeing the conjunctiva above and below the wound by cautious snips of the scissors. He then picks up the muscle on a squint hook and frees it from its surroundings, leaving the insertion intact.

If there is an assistant present, it is advisable to hand the hook over to him at this stage.

Second Stage.—Passing the Suture.—Now, taking the needle, the surgeon introduces it close to the cornea-scleral junction almost in the vertical meridian, and, taking hold at the outset of the superficial scleral fibres, passes it under the conjunctiva, until it emerges at the wound.

He then picks up the muscle, and passes the suture through

this, vertically from its upper to its lower border, varying the position with the amount of deviation, choosing a point farther back as the angle of the strabismus is larger; and then, passing the needle under the conjunctiva again at the lower edge of the wound, he makes it emerge at a point opposite the point of

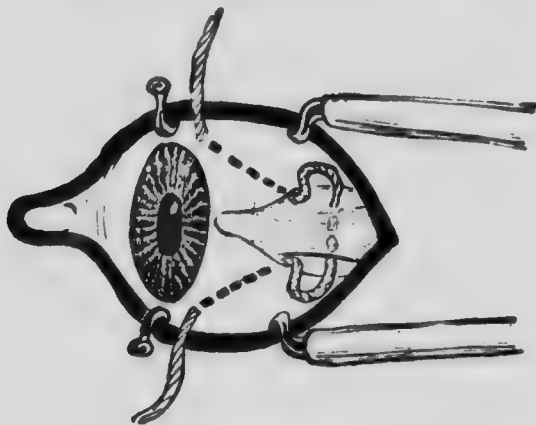


FIG. 18.—Williams' operation. *Second stage: suture in position.*

entrance, picking up the more solid episcleral tissues just before the outgoing.

This suture is not drawn tight; loops of some size are left at each side of the muscle so that the division may be made without risk to the suture.

If the course of the silk be considered, the student will see that it is entirely subconjunctival from entrance to exit, and that it is fixed at each end of its course by the more solid episcleral tissue.

Third Stage.—Division of the Muscle and Reattachment.—The muscle is now divided close to the suture, and the opponent tenotomised if this is thought necessary.

Then the ends of the suture are tied together *in situ*. The tension on the silk drags the cut muscle forwards under the conjunctiva to the margin of the cornea.

Incidentally, the tying brings up two folds of the mucous membrane, which lie more or less over the limbus, but these are not permanent, and disappear as soon as the suture is removed. It is rarely necessary to stitch up the conjunctival wound.

Argyll Robertson (22) described a similar operation.

In this he carries the sutures "in and out, over and under the conjunctiva," beyond the opposite border of the cornea.

Lindo Ferguson (23) recommends a very similar stitch, which is sufficiently explained by the diagram. Beard's method is practically identical.

Seeing that it is difficult to judge the effect of the operation for advancement, if it have been performed under chloroform, or any other general anæsthetic, it has been suggested that the final adjustment might be left for some hours until the patient has recovered from the anæsthesia. With this aim, Prince (24) described his method.

Prince's Operation

Instruments.—Speculum, fixation forceps, scissors, squint hook, Prince's forceps, needles and needle-holder.

First Stage.—The surgeon performs a preliminary tenotomy of the opponent, in the usual way.

Second Stage.—Then taking a needle with a suture he passes it through the conjunctiva at a point 1 mm. from the cornea and about 4 mm. below the transverse diameter, and makes it travel upwards beneath the conjunctiva, taking hold on the deeper tissues, until it reaches a point about 4 mm. above the transverse diameter, where it emerges. This suture, anchored to the firm deep tissues, serves as the pulley by means of which the muscle is drawn forward to the required extent.

Third Stage.—The surgeon then makes a small opening in the conjunctiva and Tenon's capsule, just below the lower edge of the muscle to be advanced, and passes in through this aperture the squint hook, under the tendon, which he lifts away from the globe. (Prince, in his original description, makes no use of the squint hook, but inserts one blade of his special forceps at once; these are now often made with teeth

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on each blade; if the surgeon try to introduce a toothed blade without the preliminary insertion of the squint hook, he will find the teeth catching in the tissues.) Then he passes alongside of the hook one blade of the Prince's forceps, the other blade remaining on the conjunctiva; when they are closed, they grasp between them the conjunctiva, Tenon's capsule and the tendon.

Fourth Stage.—The surgeon separates the tendon from the

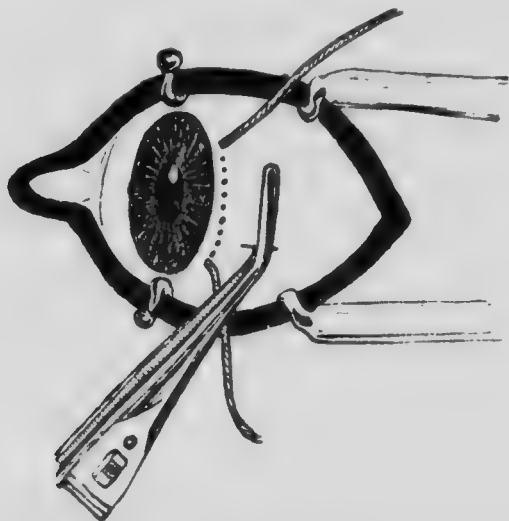


FIG. 19.—Prince's operation. *Third stage:* the pulley suture is in position, and the forceps grasp the tendon.

globe with scissors and dissects it freely back, so that he is able to see the deep surface of the muscle.

Fifth Stage.—Now he takes a suture, armed at each end with a needle, and passes both needles through the flap held in the forceps from the deep surface to the conjunctival, at a position varying with the desired result; thus he has a loop of suture on the deep surface of the muscle which is not likely to give way.

He then cuts away the part of the tendon held in the forceps at a distance of about 2 mm. from the suture.

Sixth Stage.—Laying one end of the second suture across the cornea, he ties the pulley suture over it tightly. When the two

ends of the second suture are tied, the tension on the loop draws the muscle forward to the corneal margin. It is well, Prince says, to tie the second suture in a bow, so that a second adjust-

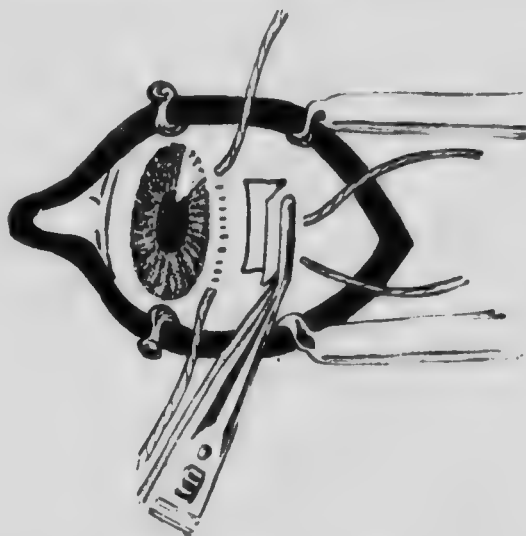


FIG. 20.—Prince's operation. *End of fifth stage: both sutures inserted.*

ment may be made at a later date if it is thought that the first is not satisfactory.

The operation may be varied in the following way, suggested, as Prince records, "by the surgeons of St George's Hospital":—

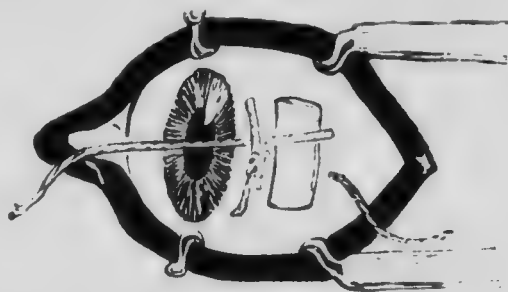


FIG. 21.—Prince's operation. *Middle of sixth stage: the pulley tied over the second suture.*

The first stage is performed as above. The second stage is omitted, and the surgeon passes on to the third stage, which, together with the fourth, is unaltered.

Fifth Stage.—The needles of the doubly armed suture are passed through the flap from deep to the superficial surface, and then one is made to travel in the same course as that of the pulley suture, which was omitted. The ends are then tied. In this modification the tissues grasped by the pulley suture act as the pulley. They are more liable to cut through and give way than in the original operation; and the modification did not receive any very great encouragement from extended trial.

O'Connor (31) points out that the chief reason for failure of advancement operations is that the stitches are always under tension from the muscle which they are holding, and that, therefore, they cut out before healing is complete. He has, therefore, sought for a method of shortening which will do away with the tension on the stitch. His operation is most ingenious, both from this point of view and from the fact that it allows a simple method of arriving at a definite amount of shortening. It is as follows: He lays bare the whole of the tendon to be shortened; then he separates, "by blunt separation," by means of an iris repositor or a small squint hook, a strip from each edge of the tendon, about 1 mm. wide and the whole length of the tendon. He then divides the central part near its insertion, and turns it back out of the way. He passes a doubly armed stitch through the insertion of the tendon; the two ends of this stitch are laid out of the way across the cornea.

He now proceeds to the temporary shortening of the lateral strips, which are to take the strain off the attaching central stitch during the healing. Taking a thread of catgut which has been made pliable by soaking in water—choosing the thickness of the catgut according to the amount of advancement desired—he lays a loop under the strip. He then passes the ends round the strip and through the loop, taking care that the ends do not cross. By pulling on the catgut, this is straightened, and the strip becomes thrown into two loops round the catgut; these loops are pressed together with forceps, and the catgut tied, not firmly enough to constrict the

tendon, but so firmly as to hold the tendon in the loops. When one strip is tied, the second is dealt with in the same way. It can be seen that the amount of shortening of the strips is equal to twice the circumference of the catgut. Thus, by selecting a catgut of appropriate thickness, the surgeon is able to shorten the tendon to any required extent. He then fixes the central part by passing the two needles of

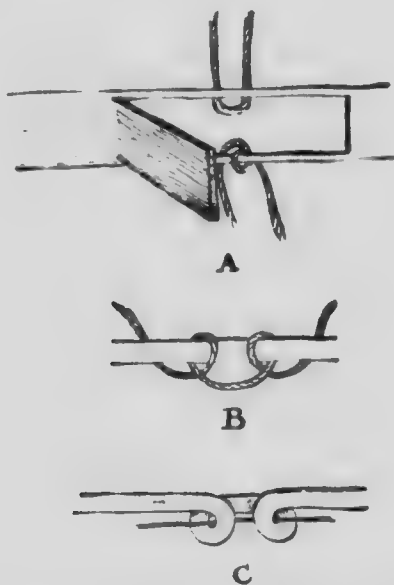


FIG. 22.—O'Connor's operation. A shows incision of tendon.
B and C method of shortening the lateral slips.

the armed stitch through it as far back as possible without putting tension on the stitch. By the time the catgut is absorbed, the two parts of the tendon are united.

GROUP 3.—Folding of the muscle without division.

Musculo-capsular advancement.—In the operation generally known under this name, the muscle is not divided, but dragged forward and folded on itself under the conjunctiva. It is supposed that in this way the attachments of the muscle to its sheath and the other fascial structures are preserved intact.

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This is not quite the case, since the surface and borders of the muscle are always exposed to some extent. The method of De Wecker (25) may be regarded as typical.

De Wecker's Operation

Instruments.—Speculum, fixation forceps, scissors, squint hook, two stout silk sutures, needles and needle-holder.

First Stage.—The surgeon makes an incision, over the insertion of the muscle to be advanced, with the scissors, and excises an elliptical piece of conjunctiva about one-third of an inch high and about one-fifth of an inch wide, exposing the muscle in its sheath.

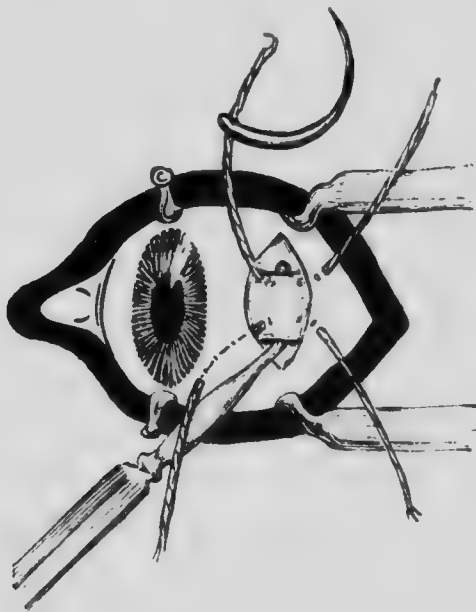


FIG. 23.—De Wecker's operation. The passage of the lower suture is complete, the upper has pierced the muscle only.

Second Stage.—He picks up the muscle on the squint hook and lifts it away from the globe.

Third Stage.—Then taking one of the sutures in a curved needle, he pierces the conjunctiva close to the outer lip of the conjunctival wound, and makes the needle travel through the muscle and sheath from before backwards into the space made by holding the muscle away from the eye. Here it passes be-

neath the hook, and then again traverses the muscle to emerge in the conjunctival wound. Now the surgeon with a fresh hold of the needle passes it under the inner lip of the conjunctival wound through the tendon close to its insertion and onward through the episcleral tissue, and finally brings it out close to the sclero-corneal junction, almost in the vertical meridian; he thus obtains a firm anchorage for the suture. The second he passes in the same way.

When they are tied the muscle is folded on itself and practically shortened.

Fourth Stage.—Before tying the sutures, the opponent must be tenotomised, if this is thought requisite.

This operation is now very commonly used instead of the usual advancement. If in Williams' operation (described above) the tendon is not divided, the muscle can be advanced in its sheath, and the musculo-capsular advancement made. Koster has recommended a procedure which is, in all essentials, this "modified Williams'" operation.

It is clear that the operation of Joëqs is not in the ordinary sense a musculo-capsular advancement: if it deserves the name, this must also be given to Critchett's method, as here described.

Bishop Harman (32) has invented some most ingenious instruments for the regularisation of this operation. The chief, the "recting forceps," is a double hook, the two parts of which slide on each other, and can be fixed by a screw at any distance, according to the amount of advancement wished. The borders only of the tendon are exposed, and the hooks passed, one under the tendon and one over it, and the two are secured. Then, by turning the whole forceps over, so that the body lies on the nose instead of on the malar bone, the tendon is folded on itself. The other instrument is a squint hook with a rasping edge, by the use of which Harman hopes to get exudation from the surface of the tendon and rapid union.

The steps of his method are as follows:

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First Stage.—An anchor stitch is passed close to the limbus, taking hold of the sclera.

Second Stage.—Two small incisions are made at the upper and lower borders of the tendon to be reefed; these pass through the conjunctiva and capsule of Tenon down to the sclerotic.

Third Stage.—The rasp is applied to the surfaces of the tendon, which then show red under the conjunctiva.

Fourth Stage.—The reefing forceps are applied, the short blade under tendon and the long over it beneath the conjunctiva, and the blades are locked in the selected position. Then, by turning the forceps across the face, the reef is formed.

Fifth Stage.—A stitch is passed twice through the base of the reef from each conjunctival opening. If the result is not sufficient, the needle, after passing through the reef, is carried forward to the limbus, where it takes hold of the sclerotic near the anchor stitch, before the suture is tied over the conjunctiva.

Trousseau (26) has recently suggested that it may be, in some cases, unnecessary to divide either the conjunctiva or the capsule to obtain an advancement of these structures, but that by means of what he calls a "capsular ligature" the desired effect may be easily obtained.

The operation is performed as follows:—

Trousseau's Operation

Instruments.—Speculum, fixation forceps, scissors, needle and needle-holder.

First Stage.—The surgeon picks up the tendon of the muscle to be advanced in the forceps, grasping it through the conjunctiva, and lifts it away from the globe. Then taking a needle carrying a ligature, he passes it through the conjunctiva near the sclero-corneal junction, through the episcleral tissue,

and then through the tendon: after running a certain distance under the muscle, it perforates it and comes to the surface again, through the conjunctiva, near the external canthus.

Second Stage.—A tenotomy of the contracted muscle is performed, and the deep stitch is tied.

A very similar suture has been used by almost all surgeons from the earliest days of the treatment of squint, but the method has not, perhaps, been so carefully studied as it has been by Trousseau.

By one of these methods the surgeon will treat cases of convergent strabismus. In face of divergence, it is rarely of much use to perform a tenotomy; division of the external rectus seldom corrects more than 5° or 7° of deviation, and an advancement of some form will in most cases be found requisite.

Since in divergence it is more common to find good vision in the deviating eye, the correction of the deviation must be as accurate as possible.

HETEROPHORIA

When there is no permanent deviation of the eyes, but only a latent displacement (heterophoria) of small degree, such operations as we have been describing are altogether too drastic for the correction of the defect. In such case the ophthalmic surgeon will usually make trial of prismatic glasses, which relieve the muscular strain. If, after fair trial, these prove inefficient, or if, from any cause, their use is impossible, he must try to improve the position of the muscles; to this end partial tenotomy has been recommended by many surgeons. Prisms cannot often be worn to correct more than 7° or 8° deviation: this will mean a prism of about 7 or 8 deviating angle in each eye, and the glass will be very heavy.

When the latent deviation is convergent and more than 8° , it will be probably necessary to divide the internal rectus of one eye; the simple tenotomy may be performed as described

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above, care being taken to spare the fascial connections as much as possible.

If the deviation is yet smaller, and glasses cannot be worn, a partial tenotomy may be tried.

Partial Tenotomy (Stevens' method)

Instruments.—Speculum, fixation forceps, small straight strabismus scissors.

First Stage.—The surgeon picks up a small fold of conjunctiva over the middle of the tendon and divides it, making a small vertical incision about 4 mm. long: if the capsule of Tenon has not been divided with the conjunctiva, he divides this by a second incision, laying bare the tendon.

Second Stage.—He picks up with fine forceps the tendon about its middle, and with the scissors makes a button-hole in it, just large enough to admit one of the blades.

Third Stage.—From this button-hole he cautiously divides the tendon upwards and downwards to the required extent, taking care to work under the conjunctiva without enlarging the wound in it.

Stevens (27), for those cases of heterophoria which cannot be sufficiently corrected by a tenotomy, has suggested a method of advancement more accurate, as he claims, in adjustment than others. It is a modification of Critchett's operation.

Stevens' Operation

Instruments.—Two pairs of locking fixation forceps, scissors, speculum, needles and needle-holder.

First Stage.—The surgeon lays bare the insertion of the muscle to be advanced, and marks the centre of the insertion by a pair of fixation forceps; then he draws the tendon out of the wound until he can fix the second pair of forceps on the centre of the tendon, at a point such that the distance between the forceps is equal to the amount of advancement determined.

Second Stage.—He then tenotomises the muscle, starting from the point of adhesion of the first pair of forceps and cutting upwards and downwards. This incision is represented in the diagram by the line *b a c*; from the extremities of the incision he cuts to the point of adhesion of the second forceps, *d* in the diagram, and excises a triangular section of tendon, the distance *a d* being the amount of advancement required.

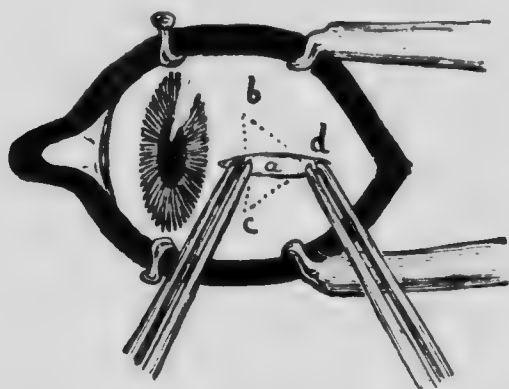


FIG. 24.—Stevens' operation. The dotted triangle bed shows the part of tendon removed.

Third Stage.—The edges of the cut tendon are then brought together and secured by sutures.

It is clear that only the central part of the tendon is advanced to the extent required, the edges being allowed to retain their old relations. It is not unlikely that the centrl. stitch will give a little.

In the case of latent divergence (exophoria), a simple tenotomy is not likely to give an effect of more than 5° or 6° ; if the defect is greater than this, some form of advancement must be undertaken. When the deviation is vertical (hyperphoria), division of the tendon has even less power of correction; a tenotomy of the superior rectus allows a downward rotation of 2° or 3° generally, and a division of the opposite inferior rectus has a little more effect in adjustment. Should there be any

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great vertical displacement, advancement is the only means of correction. In the smaller forms prisms are usually better able to give relief, and are more accurately adaptable.

Landolt (33), for vertical deviations, advises tenotomy of the superior rectus; this will give an effect of about 5° , and will not change the normal movement downwards. If, on the other hand, we divide the inferior rectus, the normal downward movement will be impaired, and the patient may suffer from diplopia on looking down. This is a much more troublesome condition than diplopia in the upper half of the field, for the eyes are much more frequently rotated downwards than upwards.

In those cases where advancement of a vertical rectus is required, Landolt holds that the defect should be largely over-corrected at the time of operation.

Cyclophoria

This condition rarely requires operation; when it cannot be relieved in any other way, it is justifiable to treat the oblique muscle at fault by advancement. If, for example, the superior oblique be found insufficient, the tendon may be sought at its insertion into the globe, just on the outer side of the superior rectus, rather behind the equator, and shortened as much as is judged necessary.

PARALYTIC SQUINT

The deviation following paralysis of a muscle may be temporary or permanent: no operation would in any case be undertaken for temporary paralysis. If one lateral rectus be paralysed, it may recover power, and yet the eye may have a permanent deviation from contraction of the opponent. Under these circumstances the surgeon will deal with the case as if it were a concomitant deviation.

If there remain permanent paresis and diplopia except in a

certain position of the head and eyes, it may be desirable to put the eye into a more convenient situation, and thus relieve the uncomfortable strain which the attitude entails. It will usually be found that an advancement is preferable to a tenotomy of the opponent, though it may be necessary to combine the two.

If there be permanent paralysis of one muscle, the surgeon cannot hope to rid the patient entirely of his diplopia; if any operation be undertaken, it will be almost entirely for cosmetic reasons, and the patient should be warned that the resulting improvement in appearance is likely to be only temporary. In such a case, again, the surgeon will make a large advancement of the paralysed muscle combined with a free tenotomy of the opponent. Under certain circumstances it might be permissible, if this operation did not satisfy the patient, to make the remaining lateral rectus inactive by dividing the muscular belly behind the attachment of the lateral elastic ligament.

This operation is practically the original method of Dieffenbach for concomitant squint, which, as we have already pointed out, was given up because the muscle often lost all power. This result, so undesirable in concomitant squint, is what we strive for in dealing with the opponent of a permanently paralysed muscle.

If all power of movement be permanently lost, the eyes may be fixed in such a position as to occasion permanent diplopia; here the surgeon may be called upon to undertake measures adapted to altering the static position of the eye, by tenotomy or advancement, or by a combination of these operations.

Paralysis of one of the vertical recti, or of an oblique muscle, is much more difficult to relieve, and the last has been for the most part regarded as irremediable by operation. Recently there appeared a paper by Dr Edward Jackson (28), suggesting that it would be possible to overcome the disturbance due to paresis of the superior oblique, at least to some extent, by operation on the superior rectus.

The explanation of the proposal is as follows:—

The superior oblique has a somewhat complicated action on

the cornea, as we have already pointed out; its functions are "intorsion" of the cornea and movement downward and outward. Should this muscle be paralysed, its functions will be taken over, in part at least, by other muscles. The downward rotation will be effected by the inferior rectus, the outward by the external and the intorsion by the superior rectus. At the same time there will be active inhibition of its opponents, which will also assist in carrying out the required movement. Thus inhibition of the inferior oblique will counteract the tendency to extorsion, inhibition of the internus will make external rotation easier. The downward rotation will be facilitated by inhibition of the superior rectus. Unfortunately the plan of compensation requires that the superior rectus should be inhibited for one action, and should act more strongly than usual for another.

The inferior rectus, acting alone in the circumstances we have imagined, with more powerful effort produces more "extorsion" than normal. The chief factor of the action of the superior rectus, in view of this, is the power to restrain extorsion, the power of elevation being even harmful. We must, then, seek to increase the power of "intorsion" and diminish the power of elevation and inward rotation. All these indications are met when we displace the attachment of the tendon outwards and backwards. The backward displacement acts like a tenotomy to diminish the power of the muscle in elevation, and the outward displacement is practically an advancement to increase the "intorsional" power.



FIG. 25.—Jackson's operation. Insertion of rectus superior. The dotted line shows the required position.

It is a matter of great importance to proportion the displacement of the insertion to the requirements of the case in hand: Dr Jackson reminds us that in all cases the adjustment

is only approximate, but that if we give nature **any** encouragement, she will make good any remaining defect. Since the globe is about a sphere of 12 mm. radius, 1 mm. on the surface of the globe corresponds to about 5° of deviation. Remembering this relation, the surgeon can obtain very close adjustments. Dr Jackson's cases, quoted in the paper, prove this fully.

Jackson's Operation

Instruments.—Speculum, fixation forceps, scissors, squint hook, half-curved needles and needle-holder.

First Stage.—The surgeon seizes the conjunctiva with the forceps over the outer edge of the superior rectus, raising an antero-posterior fold, and divides it about 8 mm. behind the cornea, rather obliquely backwards and outwards, so that an incision about 10 mm. long is made; the inner end of this incision should lie over the junction of the inner and middle thirds of the tendon, and the outer end should lie some 3 or 4

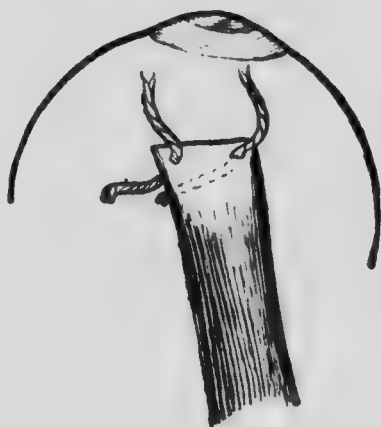


FIG. 26.—Jackson's operation. *Second stage:* The passage of the suture is complete.



FIG. 27.—Jackson's operation. The muscle attached to the new insertion.

mm. outside the tendon. The tendon is dissected a little from its connections, lifted on a squint hook and brought to sight.

Second Stage.—The surgeon now takes the needle and passes it

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through the tendon about 1 mm. behind its insertion, at the junction of the inner and middle thirds. He then carries it under the tendon to the temporal edge; then lifting the posterior lip of the conjunctival wound he makes the needle travel in the sclerotic, entering it at a chosen point, about 5 mm. behind and external to the point of passage through the tendon. The extent of traverse of the sclerotic should be some two or three millimetres, and the point of exit should lie rather behind the point of entrance: it is, of course, important to gain a firm hold without perforating the sclerotic. Finally the needle is brought again under the tendon and made to perforate it at about the junction of the middle and outer thirds from the lower to the upper surface.

Third Stage.—The tendon is divided at its insertion, care being taken to avoid cutting the suture, and this is tied, fixing the tendon in its new position.

Landolt, for similar paralyses, especially for those resulting from disturbance of the pulley of the superior oblique in operations on the frontal sinus, advances the inferior rectus, and is said to gain good success.

The last indication for operation on the ocular muscles was said to be enophthalmos. This usually arises as a substitute for excision, and the matter will be dealt with fully under this head.

The operations of Motais and Parinaud, in which the superior rectus is called upon to replace the levator palpebrae superioris, will be dealt with under the head of ptosis in the next chapter.

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CHAPTER II

OPERATIONS FOR PTOSIS

Ptosis—drooping of the upper lid—is a condition which may require surgical interference. It occurs as a congenital malformation due to want of development of the levator palpebrae superioris, or as an acquired condition following paralysis or paresis of this muscle; slight degrees of ptosis not calling for treatment result from long-standing blepharospasm, or from swelling of the upper lid, whose weight may overtask the power of the levator.

Although the lid is raised chiefly by this muscle, yet when we wish to open the eye very wide we naturally throw into action the frontalis. This tightens and draws up the skin over the eyebrows, and hence indirectly the skin of the lids. If the levator is paralysed, this accessory muscle is the only one which we can call into action, and the frontalis was the first aid which surgeons sought to remedy the defect.

On the other hand, the accessory muscle has none of the intimate association with the elevators of the globe which causes the movements of the two structures to have so close relation with each other.

This fact has therefore led some surgeons, when the levator is paralysed, to seek to use the only other muscle, viz., the superior rectus.

A short anatomical sketch of the structures involved in the various operations for ptosis is necessary for their understanding.

The upper lid is a fold made up of several layers covering the upper part of the globe. The skin is continuous with the skin of the brow, but is much thinner and more pliable. It has little and very loose subcutaneous tissue, and is reduced to fine down. Under the skin is found the *palpebrarum*, a fairly well-defined areolar muscle. It never sends fibres into the various other superficial muscles in the neighbourhood; but it is connected with the frontalis, the zygomatics, and others. It covers the tarsal plate, and is attached firmly to the inner and outer tendines oculi. The tarsal plate is a dense fibrous mass, of a semicircular shape, forming the real skeleton of the lid, continuous above with the firm orbital fascia, and though this reached to the superior border of the bony orbit, the junction of the superior and inferior tarsi form the tendines oculi, which have been alluded to already. The posterior surface of the tarsus is lined by the conjunctiva.

The muscles concerned in lifting the lid are three, of which the levator palpebræ is the most important. This arises close to the rectus superior at the apex of the orbit, and, passing forward, sends off about the equator of the globe a strong offset which splits its sheath to form the fascial funnel. At the same level the muscle receives a strong band from the underlying rectus and the tendon divides: the chief part is inserted directly into the upper border of the tarsus, but accessory bands go into the fold of the conjunctiva and to the skin; this last band consists very largely of striped muscle. By this insertion the levator contracts all the structures of the lid at once. The action of the frontalis is less direct; this muscle raises the brows and stretches the skin of the region on the stretch; in this way it is most in opening the lid when a strong effort is made, but it can be seen at once that the action is very imperfect. The rectus superior has even less action, its power being limited by the band which was mentioned above as running from the rectus to the levator tendon.

It will be realised at once that, if the levator is absent

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or paralysed, the movement of the lid is seriously impaired. Operations for the relief of this condition have as their object a better connection between the accessory muscles and the lid.

It has been pointed out in the opening words of this chapter that the forms of ptosis are multiple; the method of dealing with them will vary with the form.

It is most important to assure oneself of the presence or absence of the levator palpebræ as an active agent. When this muscle is merely weak, it is often possible to assist it by altering its insertion in such a way that it is able to act at better advantage. If, on the other hand, the muscle be entirely inactive, either from congenital or acquired defect, such a procedure is inapplicable. It becomes, therefore, a matter of supreme importance to diagnose the form of ptosis correctly. This is usually not difficult to do; the history will often be of assistance; congenital varieties are most frequently found with little or no power of the muscle. Acquired ptosis, except of very small degree, is usually due to paralysis of the levator, and is usually accompanied by some loss of power of the other muscles supplied by the third cranial nerve.

If the surgeon is in doubt as to the power of the levator, he places himself in front of the patient and depresses the eyebrow on the affected side firmly; he then asks the patient to open the eye. Any movement of the lid must be occasioned by the levator, since the depression of the brow puts it out of the power of the frontalis to raise the lid at all.

In congenital ptosis, when there is no action of the levator the muscle is often entirely absent, and the superior rectus may be absent also. In paralysis, even of long standing, the tendon of the levator will be still recognisable, and may be used, as in Sourdille's operation, as a point of attachment for the frontalis. So long as there is any prospect of improvement of the paralysis there will be no question of operation, and even when the loss of power seems definite, attempts may be made to raise the lids mechanically by means of a spring attached to spectacle frames, before any operation is undertaken.

When the ptosis depends on increased weight of the lid, appropriate treatment, by astringents, etc., will often do all that is necessary.

The earliest method of operation for ptosis was to shorten the lid so much that the pupil would be exposed and vision be possible under the raised margin. The skin of the lid was excised to a large extent; when, however, the lid was shortened enough to allow vision under it, the palpebral fissure remained permanently open, and the cornea was exposed to all sorts and degrees of injury. The procedure, as a routine method of treating all forms of ptosis, was soon allowed to drop into well-deserved oblivion.

The first important improvement in the method of operating was due to Bowman (1). He suggested shortening of the levator tendon. It is, of course, necessary that there is a tendon to shorten, and, therefore, this and all other similar methods are inapplicable to cases of absence. The method consists in laying bare the tendon, and either excising a piece or folding it on itself.

Another operation, which Bowman suggested, was shortening of the tarsal cartilage, by excision of a strip; this is, in effect, the same method as the last, since the tarsal plate may be regarded as the direct continuation of the tendon. These procedures have been modified by others, but are still useful when we have to deal with a weakened levator muscle.

When the muscle is entirely inactive it is necessary to call in the aid of the accessory muscles to raise the lid; the first and most obvious course was to increase the attachment of the frontalis to the lid. This has been done in several ways: by the making of an artificial tendon between the frontalis and the deep tissues of the lid, either of scar tissue (Pagenstecher) or of gold wire (Mules). This is a simple and efficacious operation. By attaching the skin to the frontalis (Panas, Hess); these operations are more severe than that of Mules, require longer convalescence, and leave more scar. By bringing down a strip of frontalis and stitching it into the lid

(Fergus); we have no personal experience of this method, which seems efficient. By dissecting out the tendon of the levator and attaching it to the frontalis (Sourdille, Angelucci); this regularises the pull of the frontalis, which, in Panas' operation, is exerted too much on the skin of the lid, and thus tends to produce ectropion.

This last operation is only possible when there is a well-marked tendon. In all these procedures, in which the frontalis is used, the result is not aesthetically perfect, however good be the union between the lid and the muscle; there is no connection between the movements of the eye and the frontalis; even though the height of the lid be accurately adjusted in the mid position, the relation will be lost when the patient looks up or down, owing to the want of co-ordination between the motions.

For this reason other surgeons (Motais, Parinaud) have sought to make use of the superior rectus muscle, and to connect this with the lid. The movements of the lid and eye are thus brought almost into their normal relation. The lid moves up and down with the eye.

Since, however, the superior rectus is called upon to undertake a double duty, the upward rotation of the globe is less than usual; hence there will be diplopia if the other eye have normal movement. Motais' operation, then, is applicable only to those patients who have double ptosis.

We have already drawn attention to the fact that the superior rectus is sometimes deficient in these cases, either from defect of the development of the whole muscular sheet, or from want of use (it is clear that such a patient will never voluntarily rotate his globe upwards, since this lifts the pupil entirely under the lid); Motais' operation demands an active superior rectus, and is clearly unsuitable for all cases where this muscle is even slightly weakened. Another defect is that the eye remains open during sleep, and the cornea is therefore exposed to attacks of keratitis. There has been, on this account, a reversion towards the older forms of operation.

OPERATIONS FOR PTOSIS

GROUP 1.—Shortening of lid or levator.

- (a) Excision of skin.
- (b) Excision of parts of tendon and tarsus (method of Bowman).
- (c) Folding of tendon (method of De Lapersonne, Everbusch).
- (d) Excision of tarsus.

GROUP 2.—Utilising the action of the frontalis muscle.

- (a) By artificial tendon (method of Pagenstecher, Mules).
- (b) Altering the relation of the skin (method of Panas, Hess).
- (c) Attaching strip of frontalis to the lid (method of Fergus, Roberts).
- (d) Attaching the tendon of the levator to the frontalis (method of Sourdille).

GROUP 3.—Utilising the action of the rectus superior.

- (a) Attaching a slip of the tendon to the lid (Métais).
- (b) Attaching the tendon of the levator palpebræ to the rectus superior (Parinaud, Cannas).

GROUP 1 (a).—The earliest method of treating ptosis by operation, the excision of a large piece of the skin of the lid, is now never used. When the lid was sufficiently raised by such excision to allow vision under the previously drooping margin, the cornea was permanently exposed and inflammation frequently followed.

The procedure is therefore of only historical interest, and needs no detailed exposition.

GROUP 1 (b).—The next method, due to the genius of Bowman, was shortening of the levator tendon. This is of great value when the levator is present but weak.

Bowman's (1) Operation by shortening the Levator Tendon

Instruments.—Scalpel, fixation forceps, scissors, needles and needle-holder.

First Stage.—The upper lid is everted, exposing the convex border of the tarsal plate. The surgeon makes, with the scalpel, an incision through the conjunctiva only, along the whole length of the tarsus, close to the convex border. From this he dissects the conjunctiva back, laying bare the tendon of the levator, which is inserted by its chief part into the upper edge of the cartilage.

Second Stage.—Holding the tendon well in view, he passes two or three sutures through it, about half an inch from the tarsus.

Third Stage.—He then divides the tendon in front of the sutures and excises the part intervening between the second incision and the tarsal plate, together with the extreme upper border of the latter.

Fourth Stage.—He then brings the cut edges together by means of the sutures which were placed in the tendon before division.

Maddox (17) advocates a return to the principles of Bowman's operation, with modification. He lays bare the tendon from the conjunctival surface, and shortens it by "supported cauterisation"—i.e. he makes longitudinal furrows in the tendon with the galvanocautery, and applies stitches to take the strain off the cauterised part during cicatrisation. The tendon is not divided, though he removes at times the extreme apex of the tarsal plate.

GROUP 1 (c).—Snellen (2) has suggested that it would be possible to omit the incisions, and pass sutures in such a way that when they were tied they would double the tendon on itself.

First Stage.—The surgeon passes, from the cutaneous surface, a suture through all the tissues of the lid at a level just above the tarsal plate.

Second Stage.—Then everting the lid he passes the needle

through the conjunctiva and through the underlying tendon as high as possible: the ends emerge on the skin at a little distance from one another, and are tied firmly over a roll of plaster or a piece of drainage tube. Three such sutures are necessary.

Everbusch (3) has modified the original suggestion of Sir William Bowman in the following way.

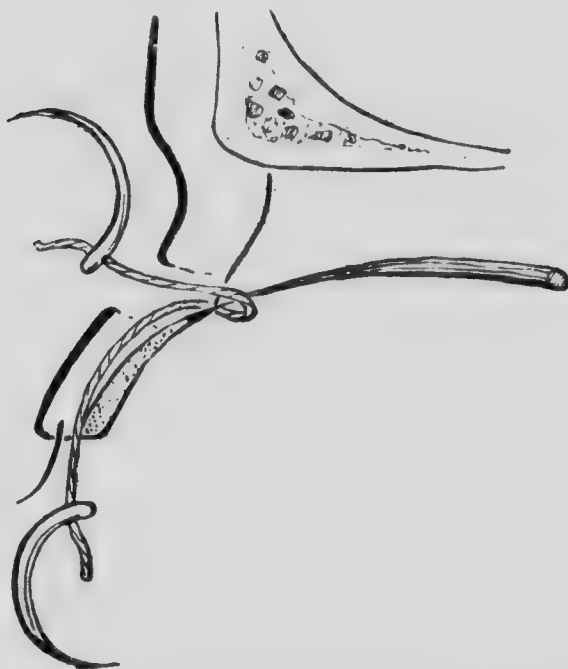


FIG. 28.—Diagrammatic section of the parts concerned in Everbusch's operation. *Middle of second stage.*

Everbusch's Operation

Instruments.—Snellen's clamp, scalpel, dissecting forceps, needles and needle-holder.

First Stage.—The surgeon inserts Snellen's clamp, pushing it up into the superior cul-de-sac as far as possible. Then he makes an incision through skin and orbicularis, in the whole

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length of the lid, at a line midway between the lashes and the eyebrow. He dissects up the lips of this wound so as to expose the tendon of the levator and the tarsal plate.

Second Stage.—He then takes a suture armed at each end with a needle, and passes it through the exposed insertion of the muscle, and after a short passage on its posterior surface, of some 2 or 3 mm., brings it again on to the exposed surface; the two ends of the suture, each with its own needle, lie on the anterior surface of the tendon, and the loop lies on the posterior surface, just beneath the conjunctiva. Now he takes each needle in succession, and carries it downwards in the cellular space between the orbicularis palpebrarum muscle and the tarsal cartilage to the free margin of the lid, where they emerge at the grey line. Three such sutures are passed, one at the centre

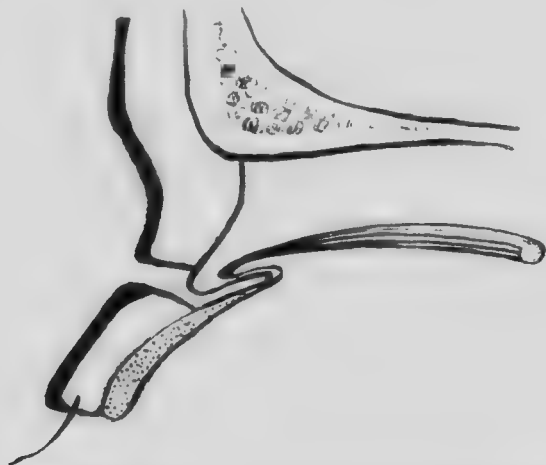


FIG. 29.—Everbusch's operation. Folding of tendon produced by sutures.

and one near each side of the tendon. When they are tied the tendon is doubled on itself and brought on to the anterior surface of the tarsus.

Very similar is the idea of De Lapersonne's (4) plan.

De Lapersonne's Operation

Instruments.—Horn or metal spatula, scalpel, dissecting forceps, squint hook, needles and needle-holder.

First Stage.—The surgeon makes an incision about 4 or 5 mm. above the free border of the lid, in its whole length, through skin and orbicularis. By slight dissection he lays bare the tarsal cartilage, its suspensory ligament, and the insertion of the levator palpebræ.

Second Stage.—From the upper border of the cartilage, at each side of this tendon, he makes a small vertical incision

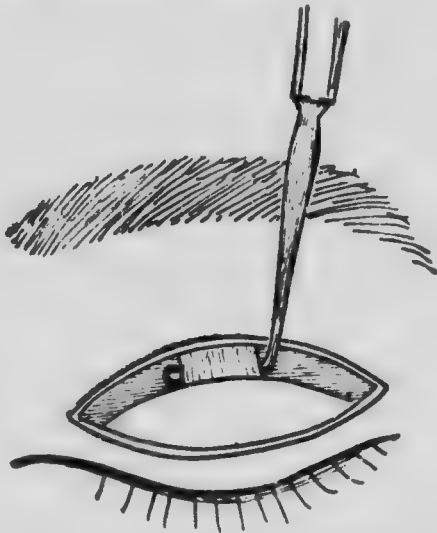


FIG. 30.—De Lapersonne's operation. Exposure of levator tendon.

through the suspensory ligament (the orbital fascia); through these he is able to pass the squint hook under the tendon.

Third Stage.—The surgeon now takes one of the sutures and passes it twice through the tendon at some distance above the hook: the point of passage will vary with the effect desired, being further back as the defect is greater: in this way, the points of entrance and exit being about 2 mm. apart, a small loop is made on the posterior surface of the tendon and both ends of the suture are on the anterior surface. Then the

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needle is made to perforate the substance of the tarsus on its anterior surface, and, after a short passage in this tissue, to reappear on the anterior surface.

A second suture is passed in a similar path on the other side of the tendon. When both have been inserted, the surgeon proceeds to the *Fourth Stage*. The muscle is cut through close to its insertion into the tarsus, and, if necessary, a piece is resected. When the sutures are tied the tendon is reattached

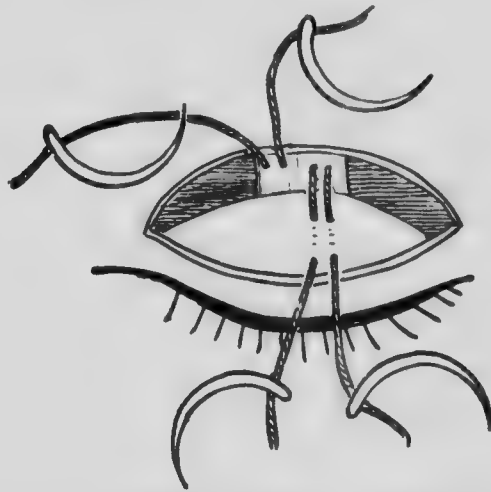


FIG. 31.—De Lapersonne's operation. Passage of sutures.

to the anterior surface of the tarsal plate, where it can act at better advantage.

If the drooping be not entirely overcome (*Fifth Stage*) a small strip of the skin and orbicularis must be removed from the lid and the wound closed by several sutures.

Wolff's Operation

Wolff (5) advances the levator either from the skin surface or from the conjunctival. His method involves division of the muscle; it is somewhat complicated and seems to have few advantages over those here described.

GROUP 1 (*d*).—In another case Bowman excised the greater part of the tarsal cartilage and reunited the fragments. This method was revived by Gillet de Grandmont (6), and has been called after his name.

The description of Bowman's operation, which is to be found in the first volume of the Moortfields' Reports, is very imperfect, but suffices to show that in idea the two methods are identical, though perhaps differing in detail. The idea is almost the same as that of his previous method, since the tarsal cartilage may be regarded as the direct continuation of the tendon.

Grandmont's Operation (Bowman's Second Method)

The same instruments are required.

First Stage.—The surgeon inserts Snellen's clamp and makes an incision in the skin of the lid about 3 or 4 mm. above the free margin and parallel to it; the incision should be about an inch in length.

Second Stage.—He then dissects up the skin on each side of the wound, exposing the surface of part of the orbicularis muscle: he excises, so that the underlying tarsal plate is laid bare almost in its entirety.

Third Stage.—He then makes an incision through the tarsal cartilage from side to side about 4 mm. from the free border, and above this another curved with the concavity downward, touching the first at either end and including in the space thus outlined the greater part of the tarsus. This is now removed.

Fourth Stage.—The two parts of the cartilage are brought together by several points of suture. It is not usually necessary to put any in the skin wound.

Gruening's method is similar; both these amount to advancement of the levator.

Freeland Fergus (15) has gone back to a similar operation, but removes more of the tarsal plate and some skin.

GROUP 2 (a).—Attachment by artificial tendon.

The first method, that of Pagenstecher, consists in passing two or more silk threads down from the forehead through the lower part of the frontalis muscle and thence subcutaneously almost to the lower border of the upper lid. Here they are made to emerge. The threads are left in until pretty free suppuration is excited all along their course. It is hoped that bands of new connective tissue will form along these sinuses, and permanently connect the lid with the muscle. This is a very rough and unsatisfactory expedient.

Mules' (7) method may be regarded as in some sense a modification of this.

Mules' Operation

First Stage.—He commences by making a small incision in the margin of the lid about its middle, some 5 or 6 mm.

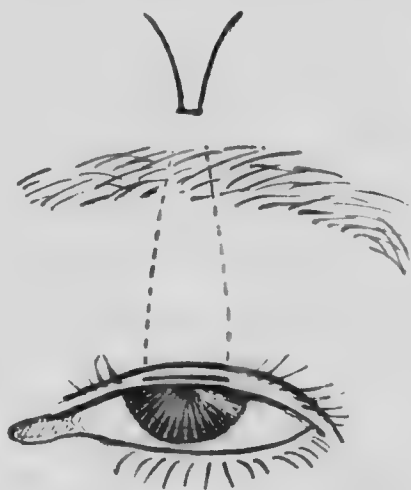


FIG. 32.—Mules' operation. The dotted line shows track of wire.

long and about 3 mm. deep. This incision is made rather behind the "grey line," which indicates the plane of connective tissue between the lashes and the tarsal cartilage, and thus invades the latter somewhat. Just above the brow a single puncture is made with the point of a scalpel opposite the middle of the marginal incision.

Second Stage.—Now a special needle, with its eye near the point, is passed

from above downwards, entering at the puncture above the eyebrow, passing through the lower fibres of the frontalis, and emerging at one end of the marginal incision. It is now threaded with very fine gold wire and withdrawn, carry-

ing the wire up to the puncture. The skin of the eyebrow is now pushed over towards the other end of the marginal incision, and the needle, again unthreaded, is introduced a second time at the puncture and made to come out at the unoccupied end of the marginal wound. Here it is threaded with the other end of the gold wire and withdrawn. We have now a loop of gold wire embedded in the tarsal cartilage near the lid margin, the two ends passing out through the frontalis. The lid can be drawn up to any required extent by tension on these ends; they must then be twisted together to form a continuous loop, attaching the frontalis to the tarsal cartilage. A little care is needed for this. The ends must be drawn a few millimetres further out of the wound, a probe laid on the skin, and the wires twisted round each other over this; then the twist is cut short, and, after withdrawal of the probe, pressed down into the puncture. The two little wounds may be closed, if necessary, by sutures.

The gold wire, which gives rise to no irritation, acts as a permanent artificial tendon.

The advantages of the method are its simplicity, the absence of scar, and the short time of convalescence. Its disadvantages are the possibility of the twist slipping, and some slight tenderness—which persists for a long time—over the gold loop.

Those patients on whom we have done the operation have been extremely pleased with the results.

Several points have been urged against this operation: it has been objected that the metallic foreign body is not likely to remain permanently in place, in a part so constantly in motion as the lid, and that the wire is apt to work out after some time. We have never known the wire extruded, although we have been able to watch patients after the operation for several years; one case was under observation for five years, and in this time nothing happened to impair the original satisfactory result.

The twist is not always sufficiently firm; on one occasion the hold slipped after about forty-eight hours. It was necessary to search for the wire, withdraw it, and replace it by another

length. Fortunately there was no difficulty in this proceeding; the accident was the result of inexperience, and not attributable to any fault of the method.

If the twist of wire is not well bent down and buried, it may perhaps work to the surface; this, again, is rather a reflection on the operator than on the operation.

It has further been objected that the incision in the lid margin leads to inversion of the lashes and trichiasis. This has not been our experience; on the other hand, if the suture be placed merely subcutaneously and not buried in the marginal tissues, the hold between the frontalis and the lid is much weakened.

Lastly, it is said that the lid cannot be everted after this operation without risk of breaking the wire; this objection is purely theoretical; no case of such accident is recorded, and, in view of the great flexibility of the wire, it is most unlikely.

To combat these points, two modifications have recently been suggested by Worth (8) and by Harman (9).

The former uses specially prepared kangaroo tendon for the suture, and does away with the necessity for a knot by a somewhat complicated and lengthy passage. The tendon is split and scraped with a knife to make it thin and smooth; it is soaked in ether to remove grease, and afterwards in a solution of biniodide of mercury; finally it is lubricated with sterilised vaseline.

Each end is armed with a Hagedorn's needle.

Worth's Operation

The field of operation is prepared, the eyebrow shaved, and the skin carefully washed. A general anæsthetic is necessary.

Instruments.—The armed suture, needle-holder, scalpel, scissors and horn spatula.

First Stage.—Two small incisions are made in the grey line of the margin, one on each side of the middle line of the lid; each is about a sixth of an inch long and about the same distance from the fellow. A third small incision—a mere puncture—is

made about half an inch above the brow opposite the middle of the lid.

Second Stage.—One of the needles is introduced at the central end of one of the incisions in the lid margin (B in the diagram) and carried upward subcutaneously, until it emerges at the central puncture above the brow; here it is re-entered and carried downwards to the central end of the other incision (C in the diagram). There is now a subcutaneous loop of tendon with the two ends emerging at the marginal incisions; each needle in turn is entered at the other end of the corresponding incision and again carried upward in the subcutaneous tissue above the brow, and made to emerge at a point on each side of the central loop (U, X, in the diagram). By drawing on the sutures at U and C, the loop V is sunk into the tissues: the loops at the marginal incisions are then drawn in and buried by traction on the ends at U and X, and the lid is raised by this traction to the required extent. Finally the needles are reintroduced at U, X, and driven subcutaneously across to the opposite sides of the brow, emerging at Z and Y respectively; the ends are cut short, and buried by slight traction on the skin.

This method leaves no scar, and, therefore, the cosmetic result is good immediately, but the shaving of the eyebrow involves a deformity lasting some weeks or even months; for a patient dependent on his appearance the method is not so good as that of Mules.

Harman's Operation

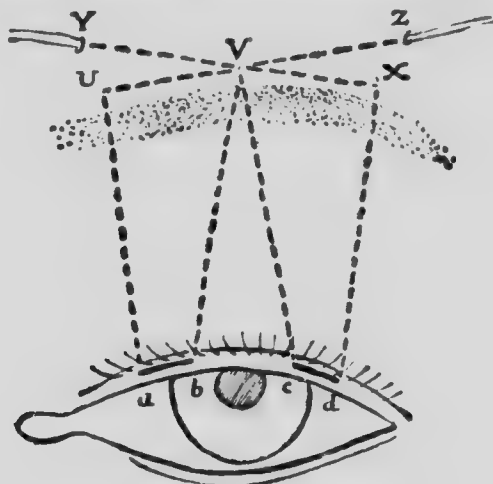
About the same time, Bishop Harman suggested another and in some respects superior modification. He points out that the kangaroo tendon is difficult to prepare, and draws attention to the statement of Worth that he was not sure of its stability in the tissues.

Harman uses a fine chain of the variety known as "wave chain," made of very fine wire, quite smooth to the touch, and weighing only two grains to the inch.

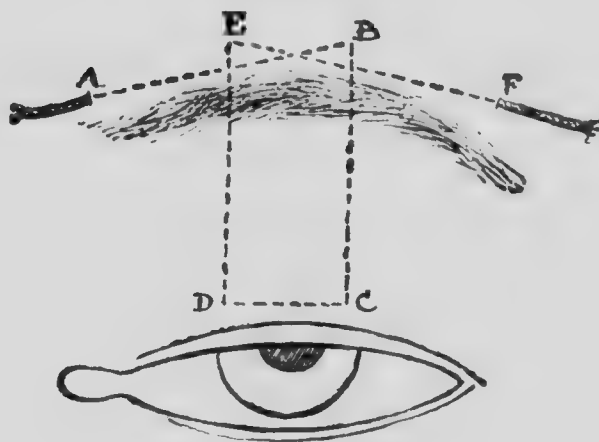
He adopts yet another path for the suture; the essential

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difference is that he avoids splitting the lid margin, by burying the chain subcutaneously just above the roots of the lashes. In this way he gets over the risk of the inversion which he says may follow Mules' original procedure. The course of



Worth's operation.



Harman's operation.

FIG. 33.—Modifications of Mules' operation.

the suture can be seen easily from the diagram. The instruments required are the chain and a needle of the usual bayonet shape. The chain may be soldered to the needle or secured to it by a piece of silk.

The needle is introduced through the skin above the inner end of the brow and carried deeply upwards and outwards to a point (B in the diagram) just external to the centre of the brow: a length of chain is drawn through, sufficient for the rest of the passage; about six inches are enough. The needle is then reinserted at B and passed deeply beneath the tissues of the forehead vertically downward in the subcutaneous plane of the lid to a point (C in the diagram) near the lid margin.

Reinserted at C, it is passed through the tarsus to a point D on the skin of the lid. Hence it passes vertically upwards to a point E above the eyebrow, and finally being reintroduced at E, it is carried to F just above the external angle of the brow.

The surgeon now raises the lid to the required extent by traction on the exposed ends, and when this adjustment has been made, cuts off the chain and buries the ends under the skin.

The parts of the chain buried under the skin prevent the lid from drooping until the granulation tissue has grown up into the spaces.

Harman recommends that the final adjustment of the height of the lid should be made some days after the primary operation, and that the ends of the chain be left long for this period, so as to allow of such adjustment.

This method is but little more difficult than Mules' plan; the avoidance of the marginal incision is—considering the thickness of the suture employed—an improvement. One great drawback to the modification is that the chain is necessarily drawn over considerable tracts of skin during its prolonged passage, and unless aseptic preparations have been very complete, there is a risk that it may be infected during this either from the skin itself or from the hairs of the brow, which are not shaved.

GROUP 2 (b).—**Panas' Operation**

In Panas' (10) operation a fold of the skin is carried upwards and fixed to the frontalis muscle.

Instruments.—Scalpel, dissecting forceps, horn spatula, scissors, squint hook, pressure forceps, needles and needle-holder.

Of these the horn spatula and the squint hook may be

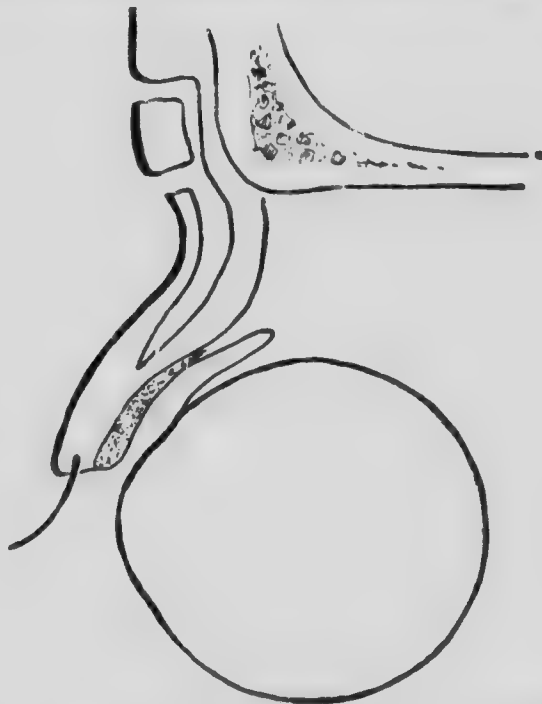


FIG. 34.—Diagrammatic section through upper lid and brow, showing parts concerned in Panas' operation

omitted, but the latter is very useful in holding parts out of the surgeon's way.

General anaesthesia is required, and the eyebrow must be shaved.

First Stage.—Stretching the eyelid over the horn spatula, he makes an almost horizontal incision in the normal fold of the lid, just below the brow, through skin and orbicularis, so as to lay bare the orbital fascia.

A second incision parallel with this is made through the skin and muscle along the eyebrow, and the bridge thus made is freed from its deep attachments and remains fixed only at its extremities.

The width of the bridge is the measure of the height to which the lid will be raised by the operation. It must therefore be accurately estimated before the second incision is made. From the lower wound two vertical cuts are made down to a point below the upper margin of the tarsal cartilage;

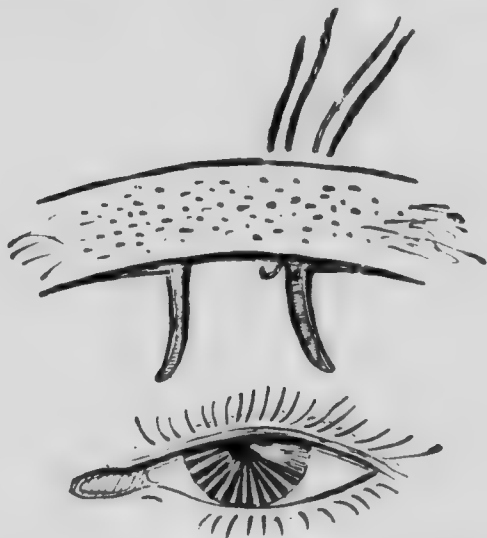


FIG. 35.—Panas' operation. Sutures on the left side only.

hence they diverge almost horizontally. The central flap thus marked out is dissected up, and left attached only by its lower part.

Second Stage—The surgeon now takes a needle threaded with thin strong silk, and passes it through the skin and muscle above the highest incision, opposite one edge of the central flap. Next, holding the bridge out of the way (and this may be done most conveniently with the squint hook), he passes the suture underneath it to the central flap, which is in turn perforated at one corner: then he brings the suture

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back under the bridge and through muscle and skin to a point close to the point of entrance. A second suture is passed in the same way, holding the other corner of the central flap. If now the four threads be drawn upon, this square of skin will be drawn up through a distance corresponding to the height of the bridge, and fixed closely to the frontalis. It will often be found that there is some little eversion of the



FIG. 56. Pars' operation. Position of parts after sutures are tied.

lid, and to correct this it is often necessary to pass other sutures to draw up the tarsal plate before the first are tied.

Taking a similar suture to those already used, the surgeon passes it through the skin and muscle nearer the canthus than the principal ones already passed, under the bridge, and, at the outer side of the "tendon" flap, takes hold, with the suture, of the orbital fascia and upper edge of the tarsal cartilage; then passes the suture under the bridge and

through muscle and skin to the surface. One such is passed on each side. These, by drawing up the skeleton of the lid, prevent eversion.

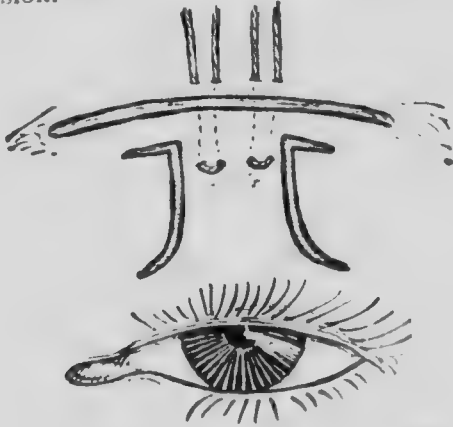


FIG. 37.—Modification of Panas' operation.

Third Stage.—All four are tied over a piece of drainage tube, and the wounds closed, as far as possible, with several stitches.

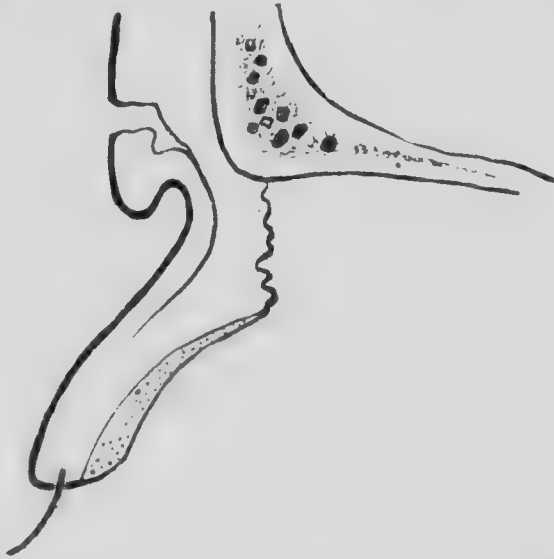


FIG. 38 — Diagrammatic section of parts in modified Panas' operation.

There are several points of disadvantage in this operation. It will be noticed that the deep surface of the bridge lies in

contact with skin, and can only be covered from its edges by growth of cells. This entails a comparatively long convalescence and a permanent dimpled scar, which, however, is much less noticeable than would be naturally expected.

On the other hand, the connection of skin and muscle is close, and the possible action is the maximum. The elevation can be gauged with great accuracy, and the operation, though its description may read slightly complex, is, as a matter of fact, very simple.

A slight alteration of the incision will allow the surgeon to avoid the objectionable coaptation of skin to a granulating surface which was mentioned as the chief disadvantage of this operation.

First Stage.—Having decided the amount of elevation desired—e.g. 6 mm.—and having made the first incision in the usual way, the surgeon makes, at a distance equal to 3 mm. below the first, two others, separated by a space about 10 mm.; from the proximate edges of these, two vertical incisions are carried downwards for about 12 mm., and then turned slightly towards the inner and outer extremities of the lid.

The whole area marked out by these incisions is then dissected up; two stout sutures armed at each end with a needle are passed through the skin at a distance of 6 mm. from the first incision at the point shown in the diagram, and then onward, under the loosened skin, to the first incision; here they sink deeply through the frontalis, to emerge above the brow. When they are drawn tight, the fold of skin is drawn up under the eyebrow to gain attachment to the frontalis. It may be said that the attachment of the skin is not so close as that in the original operation, since the dermis is not divided; this objection can be met by making an incision across the tendon flap 6 mm. from the top, and passing the sutures as in Panas' method, but taking a hold on the upper part also of the tendon flap.

The operation with a somewhat similar design is that of Hess (11).

Hess' Operation

The instruments needed are a scalpel, dissecting forceps, needles and needle-holder; to these a horn spatula and one or more pairs of Spencer Wells pressure forceps may be added as of possible utility.

First Stage.—The patient being anæsthetised, and the eyebrow on the affected side shaved, the surgeon makes an incision about two inches long through the skin only, in the line of the eyebrow, and dissects down subcutaneously almost to the free border of the lid in its whole length.

Second Stage.—Three sutures are needed, one for the middle and one for each end of the lid. They are armed at each end with a needle. One needle is passed through the skin close to the fissural margin of the lid and carried upwards, in the interval made by the previous dissection between skin and orbicularis, to the first incision; here the needle is made to penetrate the muscle deeply, and then brought out through the skin a few millimetres above the brow. The fellow needle is made to penetrate about 5 mm. from the entrance of the first, close to the lashes, and to run a parallel course to its exit. Similarly the two remaining sutures are passed. If, now, the free ends are drawn upon, the lid is raised, and the skin, folded on itself, in the position of the normal fold, is drawn up and makes a new adhesion to the muscle higher than before. The sutures, drawn up as high as is necessary, may be tied over drainage tube. The wound is closed separately.

This operation is very simple and requires few instruments. The scarring is imperceptible, being covered by the growth of hair in the eyebrow. The attachment of the skin to muscle is not so close as in the operation of Panas, and the frontalis, therefore, does not act under such favourable conditions as in the former case.

This point might be secured if the first incision was carried through the muscle as well as the skin, and the superficial layer

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be made by the dissection to include in its upper part some of the fronto-orbicularis.

GROUP 2 (c).—Fergus (12) recommends bringing a slip of the frontalis down and embedding it in the lid, on the front of the tarsal plate.

Fergus's Operation

First Stage.—The same instruments are needed. The surgeon makes an incision in the brow, about an inch and a half long; he dissects upwards, so as to lay bare the surface of the frontalis for some two inches and downwards between the orbicularis and the tarsal plate, almost to the lid margin.

Second Stage.—He dissects up, opposite the centre of the incision, a flap of the frontalis, about three-quarters of an inch broad, separating it on each side from the mass of the muscle for some two inches, and dividing it below, so that it is only attached by its upper posterior extremity.

Third Stage.—Two loops of suture are passed through the muscle flap, and the four needles, after traversing the tarsal plate in its thickness, are brought out on the skin near the lid margin. Here they are tied over a piece of drainage tube.

Fourth Stage.—The skin wound is sewn up. This operation is not difficult to perform on the cadaver, and seems satisfactory, with the exception of obliterating the normal fold of the lid, but we have never had an opportunity of seeing a patient on whom it had been performed. In the original paper an illustration depicts a very successful result.

Fergus states that he has not continued this operation, and few surgeons have imitated it. Recently Roberts of Philadelphia has described (19) a similar method:

First Stage.—After shaving the eyebrow, he makes an incision along the whole length of the superciliary border, and from the nasal end of this carries a second vertical incision up to the line of the hair. The flap thus marked out is turned up and outwards, so as to expose the occipito-frontalis.

Second Stage.—An incision is made through the skin of the lid just below the upper margin of the orbit, and the flap

below this is turned down until the upper edge of the tarsal plate is exposed. The bridge of skin between the two horizontal incisions is undermined to form a tunnel from one wound to the other.

Third Stage.—The surgeon makes two incisions vertically through the occipito-frontalis, about 8 mm. apart and 30 mm. long, opposite the tunnel. A cross cut joins these at the top.

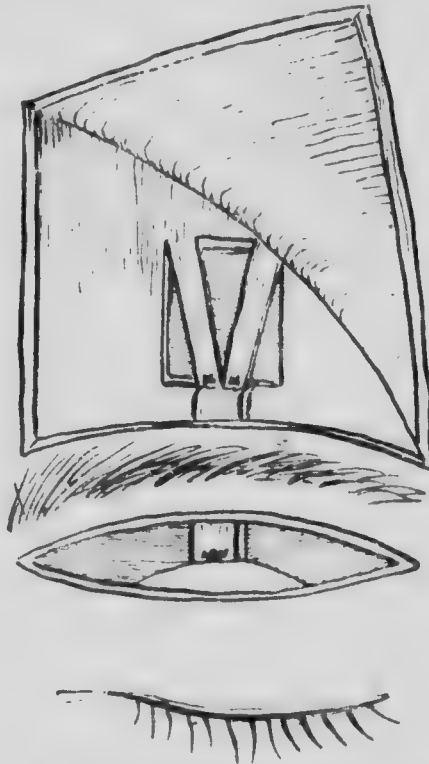


FIG. 39. Roberts's operation. End of fifth stage.

The flap thus made is turned down, slipped through the tunnel, and secured to the upper part of the tarsal plate.

Fourth Stage.—A narrow strip about 4 mm. wide is cut on each side of the gap in the muscle left by turning down the flap; the strips are left attached by their upper edge only.

Fifth Stage.—The strips are secured to the turned-down flap and to each other.

Sixth Stage.—The wounds in the skin are sewn up.

GROUP 2 (d).—Another plan is to attach the tendon of the levator palpebræ superioris directly to the frontalis, so that, when this latter muscle acts, it draws on the normal mechanism for raising the lid. There are two varieties of this method, described by Angelucci (13) and Sourdille respectively.

Angelucci's Operation

Instruments.—Scalpel, dissecting forceps, squint hook, scissors, two sutures armed with needles at each end, needle-holder.

First Stage.—The surgeon makes a curved incision about an inch long a little below the eyebrow, and parallel to this. From this incision he dissects downward, keeping close to the skin, to within a quarter of an inch from the lid margin, and then makes a pocket under the frontalis, beneath the centre of the brow.

Second Stage.—He then cuts through the fibres of the orbicularis in a horizontal line about 3 mm. above the upper border of the tarsus, and through the orbital fascia, laying bare, at once, the insertion of the levator into the tarsal plate.

Third Stage.—He now passes a squint hook under the tendon, and, drawing it forward, divides it about 4 mm. from the tarsus.

Fourth Stage.—Now, taking the suture, he passes both needles through the flap of tendon, so as to leave a loop on the anterior surface, and carrying them upwards into the pocket under the brow, he makes them emerge through the skin above. In the same way the second suture is passed. When these are drawn taut, the tendon flap is brought into contact with the deep surface of the frontalis and becomes attached to this.

Fifth Stage.—The skin wound is sewn up.

Angelucci recommends that the final adjustment be made some days after the operation, but it would seem unwise in this as in other operations to interfere at such a date with the new-formed adhesions.

The disadvantages of his operation are that it is not possible if the levator is wholly absent, and that it effaces to some extent the normal fold of the lid. Sourdille's (14) method aims at avoiding this slight deformity.

Sourdille's Operation

First Stage.—The same instruments are needed. The surgeon makes an incision about an inch and a quarter long, curved so that its two extremities are some 3 mm. below the brow and the summit of the convexity a little above it. The incision is deepened through the fronto-orbicularis. The flap thus marked out is dissected up, so as to lay bare the orbital fascia just

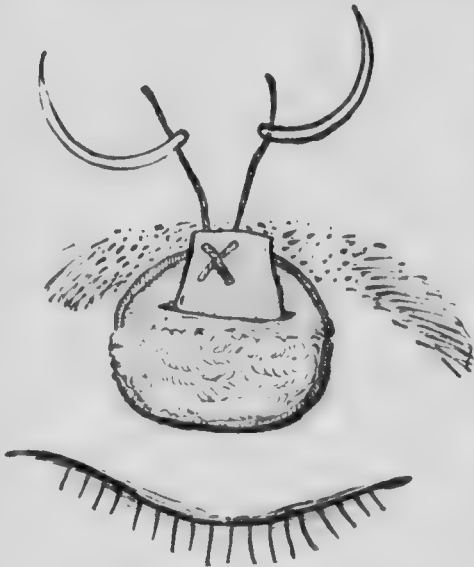


FIG. 40.—Sourdille's operation. The skin flap is turned down and the tendon of the levator drawn through an incision in the orbital fascia.



FIG. 41.—Diagram to show relations in the final stage of Sourdille's operation.

below the bony margin of the orbit. A pocket is made under the frontalis.

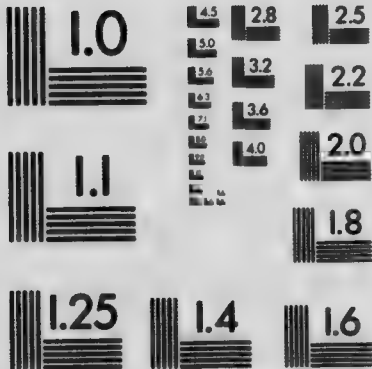
Second Stage.—He now cuts through the fascia quite close to the bony attachment; a few lobules of fat present in the wound; these are pushed on one side and the tendon of the levator comes into view. The surgeon passes the squint hook behind this and pulls it well out of the wound.

Third Stage.—Then, taking a doubly-armed suture, he pierces one side of the tendon from behind forwards with



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both needles, and then, carrying them upwards, crosses the threads and pierces the tendon again with both needles at a higher level (suture "en X"). A similar suture is passed at the other side of the tendon.

Fourth Stage.—The tendon is divided behind the hook and the needles carried up into the pouch under the frontalis, to emerge on the skin after perforating this muscle.

Fifth Stage.—Lastly the skin wound is closed.

By incising the fascia close to the bone, Sourdille thinks that the lower part will act as a pulley round which the tendon of the levator can play. At the same time the fold of the lid is not obliterated. Clearly this operation, also, is inadmissible, if the levator is absent.

Calderaro (20) has found it unnecessary to divide the tendon of the levator, since the loop held on the hook can be drawn with moderate force so far that it can be sutured to the frontalis on the level of the eyebrow.

GROUP 3.—Operations making use of the superior rectus (methods of Motais (15) and Parinaud).

GROUP 3 (a).—Motais' Operation

The method of Motais is, theoretically at all events, in some respects more scientific than those others which we have already discussed.

Instruments.—Sharp hooks, squint hook, scissors, fixation forceps, scalpel, needles and needle-holder.

The operation is divided into several stages. A general anæsthetic is not always necessary, and when it can be dispensed with the surgeon is much better able to judge of the probable success of the procedure.

First Stage.—The upper lid is everted and drawn upwards by a sharp hook, and the globe of the eye is drawn down by another, so as to expose the whole cul-de-sac of the conjunctiva. A horizontal incision about 15 mm. long is made in the conjunctiva over the insertion of the superior rectus muscle, and from the middle of this a second is carried

upwards vertically until it reaches the tarsus. Then the conjunctiva and the capsule are dissected away from the tendon by scissors.

Second Stage.—The surgeon passes a squint hook under the bared tendon and depresses the globe with it, removing the sharp hook from the sclerotic; then seizes the middle

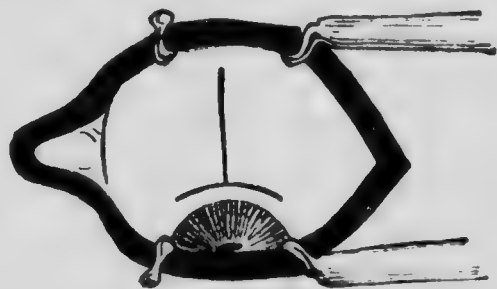


FIG. 42.—Motais' operation. Incisions in the conjunctiva.

fibres of the tendon 2 or 3 mm. from its insertion and divides them transversely, making an incision 3 mm. long. From the extremities of this transverse incision he makes other vertical incisions 10 or 12 mm. in length, so as to isolate the

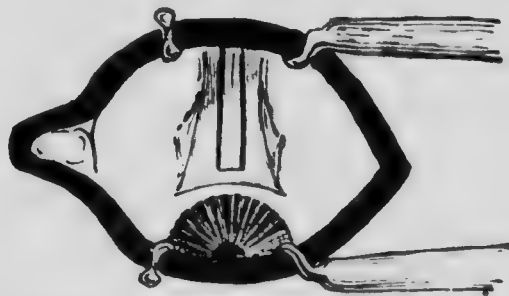


FIG. 43.—Motais' operation. Median slip of tendon marked out.

middle portion of the tendon, which remains attached to the muscle only by its posterior (upper) end.

Third Stage.—A small incision is made through the orbital fascia just above the tarsus, and the anterior surface of this plate is cleared slightly.

Fourth Stage.—Through the flap of tendon close to its

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anterior extremity, and from the superficial to the deep surface, are passed two needles at the ends of a single silk suture, so that the tendon flap is held by a loop of silk.

These needles are then passed through the hole in the orbital scia, and made to perforate the tarsal cartilage from before backwards at a point varying according to the effect required. The ends of the suture are tied over the conjunctiva, and the effect can be immediately observed; if the lid is not sufficiently



FIG. 44. —Diagram of parts in final stage of Motais' operation.

raised the needles may be withdrawn through the tarsus and reintroduced nearer the fissural margin. If the opening is too wide, the suture may be slackened a little.

Fifth Stage.—The conjunctival wound is sewn up.

The operation is not much more difficult than advancement, and seems to have many advantages. It ensures that relation between the direction of regard and height of the lid which during waking hours at least is almost constant,

but it has some disadvantages and risks; the knot on the mucous surface of the lid has in some instances caused very troublesome ulceration of the cornea, which has seriously interfered with vision afterwards.

In the practice of the originator no difficulty has followed in regard to weakening the elevators of the globe, but others have found the upward movement impaired, and the patients have complained of troublesome diplopia on looking up.

Stephenson (21), with a view towards simplifying the procedure, advises that the outer half instead of the middle third of the tendon be attached to the lid.

GROUP 3 (*b*).—Parinaud's (16) Operation has a somewhat similar form, and is based on the same principle, *i.e.* the use of the rectus superior.

Instruments.—The same instruments are necessary.

First Stage.—The upper lid is everted. The surgeon grasps the conjunctiva near the upper edge of the tarsus and makes a horizontal incision through the mucous membrane parallel with the tarsal plate.

Second Stage.—Rotating the eye downwards with forceps or, if necessary, with the sharp hook, he searches for the tendon of the rectus through the incision just made, dissecting up the conjunctiva as far as may be found requisite.

Third Stage.—Taking a suture armed with two needles, he passes it under the muscle and the adjacent capsule. Each needle, then, is made to perforate the conjunctiva near the edge of the wound, and then passes through the tendon of the levator palpebræ on to the anterior surface of the tarsal plate between which and the skin it travels to the lid margin, coming out close to the lashes. The points of exit should be about 7 or 8 mm. apart. The ends are tied over a piece of drainage tube.

Calderaro (20) has slightly modified Parinaud's operation, and is much pleased with the result. The chief difference is that he makes a vertical incision in the conjunctiva, from the

tarsus almost to the limbus corneæ, and fixes, by catgut stitches, the rectus tendon to the tendon of the levator; measuring the distances at which the sutures perforate the tendons, so that the distance from the stitch placed in the rectus to the junction of the upper and middle third of the cornea is the same as the distance from the edge of the lid to the place of perforation in the tendon of the levator.

Cannas, at the meeting of the Italian Ophthalmological Society in 1902, proposed another method. He makes a vertical incision through the skin in the middle of the lid and lays bare the tendon of the levator, which he divides about 6 mm. behind the tarsal plate. He then seeks for the rectus superior through the same incision, and stitches the cut tendon to the rectus. This operation excludes all action of the levator and is therefore inapplicable to those cases where it is merely weak.

Comparing these two cognate methods, we see that in the latter the muscle, the rectus superior, is less disturbed than in the former, and therefore the results are less likely to include permanent diplopia on looking upwards from weakening of the levator. On the other hand the adhesion between the lid and the adjuvant muscle is less close in the operation of Parinaud than in that of Motais.

It is clear that neither of these methods are applicable unless the rectus superior is normally developed. Unfortunately, since this muscle and the levator are parts of a single muscular sheet, both are not infrequently affected together.

We have already mentioned some other defects: the liability to disturbance of the muscular equilibrium is enough to act as a great deterrent to the general use of these procedures.

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CHAPTER III

OPERATIONS ON THE LIDS

A SHORT preliminary sketch of the structure of the lids must precede any account of the various operations which have been devised to correct their diseased conditions.

The lids are made up of a number of planes of tissue. The skin is very thin and supple, covered by very fine down, but having no hairs of any size (except the eyelashes at the margin). There is practically no subcutaneous fat; the subdermal connective tissue is very lax, so as to allow free, rapid movements. Into this tissue effusion of blood or lymph may take place very rapidly and copiously; but it cannot spread back easily into the orbit, because the mouth of this cavity is closed by a strong fascial sheet. Hence inflammation of the eyelids is rarely followed by orbital cellulitis.

Under the cellular tissue, but superficial to the fascial sheet just mentioned, lies the orbicularis palpebrarum, a well-marked circular muscle surrounding the palpebral fissure: internally and externally it is anchored to the bone by a fibrous band or tendo oculi; the internal of these is much the stronger, and passes across the anterior surface of the lacrymal sac to the nasal process of the superior maxilla.

Above and below, the fibres of the muscle are connected with the other superficial muscles in the surrounding parts.

Under the orbicularis is another plane of cellular tissue, which separates the muscle from the skeleton of the lids, the so-called tarsal cartilages or plates.

These two are masses of dense fibrous tissue, crescentic in outline, extending from the palpebral aperture into the lids; the upper is the larger and stronger. They fuse at the inner and outer canthi, where they are connected with the tendines oculi. If we trace them away from the fissure, we find that they thin out, at first gradually and then somewhat suddenly, into the fascial sheet which was spoken of above as closing in the orbit, and thus they are attached all round the bony margin.

The cellular interval in front of the tarsal cartilage is shown on the edge of the lid by a thin "grey line" behind the lashes. This line forms one of the most important landmarks in all lid operations.

A few points in relation to all operations on the lids must always be in the surgeon's mind. The incisions which mark out the flaps must be planned with care before the actual operation is undertaken, so that the flaps may when necessary be made and placed in their new position as rapidly as possible. As a general rule they are almost entirely separated from the body, and therefore possess little vitality. It is all-important, therefore, that they should be shaped and fixed in their new position with as little handling and bruising as is possible, and that the fixing sutures should be as few as is consistent with safety. All such operations must be aseptic.

For most of them a general anæsthetic is desirable. The performance cannot be hurried. Each step must be made accurately and carefully; on the proper performance the whole success of the operation depends.

Free bleeding would greatly interfere with the comfort and convenience of the surgeon. The operations are usually made "bloodless" by the use of Snellen's clamp.

In passing sutures, it is well, when possible, to pierce the movable flap first, and then to pass the suture through the lid at the selected point.

The first dressing should be left on for two or even three days without disturbance; at the end of three days it is usually

safe to remove superficial sutures, but deep ones may be left in for five or seven days.

CONGENITAL DEFORMITIES

Congenital deformities of the lids, of sufficient importance to need operation, are among the rarities of ophthalmic surgery. When they exist they may affect the lid in almost any part; the commonest deformities are, perhaps, the following: epicanthus, coloboma, distichiasis, and maldevelopment of the puncta lacrymalia and canaliculi. This last condition will, most naturally, be dealt with under the head of the lacrymal apparatus.

Epicanthus may be divided into two varieties, which may be called: (1) simple or temporary, and (2) permanent or "mask-like" epicanthus. The former is found, usually in young children, as a small fold of skin with the free concavity downwards and outwards, bridging over the inner canthus, and thus giving rise to a trifling deformity; rarely the fold looks upwards and outwards.

It can at once be made to disappear by pinching the skin over the bridge of the nose, and in most cases it vanishes spontaneously with the growth of the child as the bridge of the nose develops.

It is, therefore, most inadvisable to operate during childhood, unless and until it has become clear that no improvement is to be expected from natural growth. Should an operation have been performed and the bone undergo its normal development afterwards, the scar will yield and from a line, become an area, which from its prominent position is more disfiguring than the condition for which it was undertaken. If, owing to any defect of bony growth, the failure of disappearance is permanent, some operation may be justifiable.

The procedure most frequently adopted is that devised by Von Ammon.

Von Ammon's Operation

Instruments.—Scalpel, dissecting forceps, scissors, needles and holder.

First Stage.—The surgeon estimates the amount of skin, which must be removed, by pinching it up over the defective bridge of the nose. He marks out the extent of this area with a pencil.

Second Stage.—With the scalpel and forceps he excises the fold marked out.

Third Stage.—He brings the edges of the wound together with several sutures. The tension of the stitches holds the folds stretched out. Healing is usually rapid, and the resulting scar is a mere line.

Wicherkiewicz' Operation

Wicherkiewicz (1) published a short account of an operation which he has devised for this deformity. Since the fold covers the inner canthus and runs down and up into the lids, the surgeon should endeavour by his operation to affect the centre of the fold more than the lateral regions. Wicherkiewicz has had this in view.

First Stage.—From a point about 1 cm. away from the internal canthus, and in the same horizontal line, the surgeon makes two diverging incisions, enclosing an angle of about 60° and reaching almost to the base of the fold. From the extremities of these two others are cut converging to a point about 5 or 6 mm. nearer the canthus, and thus meeting at a larger angle than the first. These four lines mark out a trapezoid of skin, with a re-entering angle towards the base of the fold.

Second Stage.—The skin contained within this area is then removed, and the edges of the raw area brought together by means of five sutures.

In the more severe degrees epicanthus is combined with imperfect development of the face, and is, in fact, only a part of this condition. The skin is tight and unwrinkled; the pal-

pebral fissures are small, and there is a want of expression and general fixity of appearance which has suggested the name "mask-like" epicanthus for the state. It has been noted in some cases that there is, associated with the deformity of the lids, wrinkling of the brows from overaction of the frontalis muscle. Whether this overaction is secondary

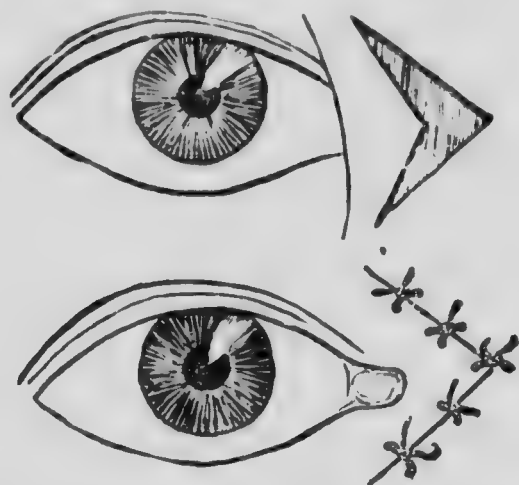


FIG. 45.—Wicherkiewicz' operation. The upper figure shows the area of skin removed; the lower, the final result.

to the maldevelopment of the lids, or primary, arresting by pressure the proper growth of the bones, as some have suggested, may be left undecided. There is no doubt that all the bones of the region, as well as the skin and muscles, are abnormal. The result is an undue tightness of the skin.

In such cases Foggin (2) has proposed to deal with the deformity in the following way, with the object of slackening the tension of the tissues and thus removing the obstacle to the normal bony growth.

Foggin's Operation

Instruments.—A tenotomy or linear cataract knife, needle, needle-holder, specially shaped lead plates over which to tie the sutures.

First Stage.—The surgeon passes the knife through the skin at the side of the glabella, and separates, subcutaneously, all parts from the nasal bones and their immediate neighbourhood.

Second Stage.—He is now able to pick up a fold of skin in the region of the defective bridge of the nose large enough to form a bridge.

He passes the sutures through this fold from side to side, and ties them through holes in the specially prepared lead plates.

COLOBOMA

Coloboma of the lid is never a common deformity, and very seldom so marked as to require operation. When it occurs it is found as a more or less deep notch in the upper or the lower lid. Although it would seem probable that the notch be due to some imperfect closure of the facial clefts, yet it is hard to explain the varieties of position by any reference to the known facts of the development of the face. The malformation of the lid is not unfrequently associated with coloboma of the choroid, which, of course, cannot be due to defective closure of the facial clefts.

The coloboma is usually a mere nick in the lid margin, only to be discovered on careful observation and readily passed over; such, therefore, needs no treatment. If the notch be so large as to expose the cornea permanently in whole or part, it will probably be advisable to close it, not only for the deformity, but also to prevent injury of the cornea from foreign bodies. The operation may be considered as a form of tarsorrhaphy, a procedure which will be described fully later.

The margins of the gap must be pared and the raw edges brought together and fixed accurately in apposition by several sutures.

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The chief difficulty of dealing with coloboma of the upper lid is to make a satisfactory margin by operation. Peschel (3) describes a method of procedure which he adopted in a case of traumatic coloboma, with good results; the chief point in it is, that he makes a rectangular gap in the tarsal plate, by excising the triangular area on each side of the unclosed wound, and fills it by displacing a similarly shaped piece of the cartilage downwards. The operation seems, at first sight, unnecessarily complex, but the regularisation of the margin is a point of real importance, and further experience of the operation is necessary before it can be decided whether it be preserved or not.

DISTICHIASIS

Occasionally the lashes are arranged in two rows, of which the posterior is inverted and brushes against the eye. This condition is known as distichiasis, and requires operation sometimes. It may be considered for practical purposes a subvariety of trichiasis, and should be dealt with by one of the methods which will be described under that head.

Lastly, the puncta lacrymalia may be congenitally deformed. These conditions will be found treated of in the chapter on the lacrymal apparatus.

OPERATIONS FOR ACQUIRED DISEASE OF THE LID

The conditions of the lids in disease which may require operation are numerous; among the most important are two which relate chiefly to the position of the lid-margin and the lashes.

Often, from one cause or another, the lashes are turned inwards and brush against the globe. This condition, known as trichiasis, or, in the more marked degrees when the whole margin is inverted, as entropion, is both inconvenient and dangerous—inconvenient because the brushing lashes give rise to constant discomfort; dangerous because the friction gives rise to opacity and frequently to ulceration of the cornea, which may be entirely destroyed as a result.

It is therefore necessary, as well for hygienic as for cosmetic reasons, to correct any such deformity.

On the other hand, the lid may fall or be drawn away from normal apposition with the globe—a condition known as *ectropion*, because the palpebral conjunctiva is turned outwards.

The eye here is unusually exposed to injury owing to the absence of the normal protection. The cornea is in some cases always exposed, and therefore its epithelium becomes dry and thickened.

If the lower lid be affected there is more or less constant overflow of tears, which causes *eczema* of the face, and the exposed mucous membrane is constantly inflamed and unsightly.

ENTROPION

Entropion is due either to irregular spasm of the orbicularis or to cicatricial contraction of the deeper structures of the lid. Spasmodic entropion always affects the lower lid, and is rare except in advanced age. The tarsal cartilage in the upper lid is too strong for the orbicularis to bend.

It often happens, when in an old person the eye has been kept bandaged for some days, as after an operation, that, when the bandage is removed, the lower lid is found doubled on itself and its lashes turned downwards into the *cul-de-sac*.

When this occurs, it is always a troublesome complication, and may lead to the patient's undoing. The lashes not only act as a mechanical irritant, but often introduce micro-organisms into the eye, which may interfere with the normal healing.

Sometimes the lid may be replaced by simple means until the bandages can safely be discarded. Then no operation will be necessary, the recovery being spontaneous. Reposition can always be effected temporarily by the finger, drawing the skin of the lid downwards and rolling out the inverted margin and the lashes.

When thus replaced, the lid may be held in position by contractile collodion or strapping; or if these are insufficient,

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sutures may be passed as follows :—The surgeon takes a suture with a needle at each end; he makes one of the needles pierce the skin close to the lashes, and descend subcutaneously in a vertical direction to the lowest fold of the lid, where it emerges. The second needle is passed subcutaneously along a parallel line, making entrance and exit at points about one-eighth or one-sixth of an inch from the course of the first needle.

One such suture is passed at each extremity of the middle third of the lid. When pulled tight and tied round a drainage tube, the skin of the lid between the points of entrance and exit is wrinkled up into folds, and the lashes are everted.

These sutures should be left in until the healing of the original wound is completed and the bandages are finally left off.

If the vicious habit still continues, and the entropion returns after the removal of the sutures, the redundant skin and the underlying portion of the orbicularis must be removed.

For this operation a general anæsthetic is usually necessary, but it may sometimes be performed without.

The instruments needed are a Beer's knife, curved scissors, dissecting forceps, needles and needle-holder; a horn speculum may be added.

An incision is made about 3 mm. from the lashes in the whole length of the lid. This is made most easily by stabbing the Beer's knife through the skin with the edge forwards, and then running it along as far as is necessary, the back resting on the lid.

A second crescentic incision is made (more readily with scissors than with a knife) below this, joining the first at each extremity. The contained skin and the underlying muscle are rapidly removed, and the edges brought together by three or four sutures.

When the tissues of the lid are very loose, it makes the operation easier to put them on the stretch by the flat horn.

The resulting scar is small and readily overlooked. The cure is usually complete and permanent.

Some surgeons remove, instead of a horizontal ellipse of skin, one or more small vertical ellipses.

This operation is attributed to Janson, of Lyons (24), and has from time to time been revived. It is claimed that the vertical scar prevents the relapse of entropion, which certainly occasionally follows the horizontal excision. Desmarres did not regard it with favour.

Some surgeons combine the two procedures by adding a small vertical excision, usually to the outer side of the horizontal. Janson's operation is certainly faulty in producing a scar which does not lie in the lines of the normal folds of the lids.

CICATRICIAL ENTROPION

Cicatricial entropion depends for the most part on one of two causes—it is due either to some contraction of the fibrous tissue about the individual hair-follicles, or to the deposition and subsequent contraction of new fibrous tissue, laid down during an attack of chronic conjunctivitis, in the subconjunctival tissue and the posterior layers of the tarsal plate. Clearly the result will differ in degree with the form and extent of the contraction.

In the former instances the tarsal cartilage will preserve, almost if not quite intact, its normal curvature; in the latter the bent tarsal cartilage will form a prominent angle, as the result of the forcible contraction.

Treatment will vary with the form and degree of deformity. The typical cause of the former variety of trichiasis—that in which the deformity is almost confined to the maldirection of individual lashes—is long-standing blepharitis. In such instances the lid margin is much deformed, and treatment may be confined to the immediate edge without attacking the remainder of the lid.

Many operations have been devised, having for their aim the reconstruction of the normal lid margin, or merely the removal of the lashes from the danger zone.

When only a few cilia are misplaced, we may deal with them individually in many ways—by repeated epilation, by electrolysis

or excision of the affected bulbs, or by attempting to alter the direction of the several hairs.

Practically epilation is often the most convenient. The hair must be seized near the root with smooth forceps and drawn firmly out of the follicle; any jerk is liable to break the hair, whose sharp end will be more irritating than ever.

The removal of the hairs must be repeated as often as they grow, but patients soon learn to pull them out for themselves, and often become very skilful in the little operation.

It has been suggested that, since the faulty direction of the hair is largely due to the maldirection of the mouth of the hair follicle, we might make a new track for the lash which would modify its position.

To effect this we introduce a small curved needle down the opening of the hair follicle, and force it onwards to the point at which it is desired to bring the hair. We then thread the lash into the eye, and, withdrawing the needle, bring the lash into the new track; but, unfortunately, when the lash is thrown off the new hair will almost certainly retake the old curve.

A better method is destruction of the hair follicle by electrolysis.

If more than a few hairs, or if all in one region of the lid are affected, such methods as epilation and electrolysis are not advisable, since by removing the lashes they rob the eye of its normal guards.

The surgeon must, therefore, adopt some other method, so that the lashes may be preserved, but put into a position where they will not damage the eye.

The choice of the procedure will vary with the amount of deformity. It is necessary in all cases to be sure, if possible, that the cicatricial contraction has run its full course, otherwise an operation which is efficient when done may prove in six months entirely inadequate.

The earlier surgeons, in treating entropion, did not sufficiently recognise the importance of preserving the lashes. Flarer, indeed, suggested the excision of the whole lash-bearing zone, by two incisions, one in the grey line and the other above the roots

of the hairs on the skin; the inconvenience of the results were soon apparent, but the operation is of historical importance, because it is the ancestor of many others, having for their aim the removal of the lashes from the margin. One of the first modifications, still not infrequently performed, is that of Arlt. In this, the lash-bearing area is raised as a bridge from the lid by means of two incisions, a piece of skin is excised from the lid above the bridge flap, and the bridge is reseated higher up. There is left a raw area near the lid margin, which fills up by granulation.

This involves a somewhat lengthy convalescence, and various methods of filling the gap have been suggested. Some fill with skin; this has a radical defect, since the downy hairs of the skin are brought into contact with the cornea, at the lid margin, and give rise to as much irritation as the lashes. Others fill with mucous membrane, a much better plan, and one most valuable when the deformity depends on malformation of the lid margin only.

Van Millingen's operation, or some modification thereof, is the best way of applying this method. It is simple, applicable to either lid, and the convalescence is short.

It has already been remarked that the chief cause of cicatricial entropion is to be sought in the increased curvature of the tarsal plate which follows the deposition of fibrous tissue in the deep subconjunctival layers; so long as this structure retains its faulty shape no real cure is possible. The tarsus in old trachoma forms a prominent angle directed forwards: this angle is situated some five millimetres above the free edge of the lid, at the point where the normal curve of the lid is steepest.

Unless this malformation be corrected, the entropion cannot be cured. The offending angle has been attacked from both its cutaneous and its conjunctival surfaces: the latter procedure is the characteristic feature of the operations of Williams and Lagleyze; the former route is chosen by Streatfield, Snellen, Knapp, and Barrett.

The principle of the former operations is to divide the tarsal

plate from the inner side and to trust that the cicatricial material thrown out in the course of healing will act as a wedge between the edges of the plate and thus correct the curvature, an expectation which is not always justified, especially when the deformity is extreme.

On the other hand, the surgeons who attack the cartilage from the anterior surface, for the most part actually excise so much of the tissue as may be necessary to allow the plate to resume its proper curve; this method, therefore, if a little more severe, is better able to deal with the worst cases. There is another point, too, which must be borne in mind. If the tarsus is divided from the conjunctiva, the wound cannot be kept aseptic, because it is in communication with the conjunctival sac, which in these patients is always swarming with micro-organisms. Sometimes there follows some painful sup-
puration of the lids.

Anagnostakis tried to bend the cartilage straight by increasing the tension on its anterior surface; he stitched the skin up tight to the upper border of the cartilage without any division of the latter. His method found few followers, but has been utilised, in conjunction with division of the tarsal plate, by Williams, and in almost its original form by Hotz.

OPERATIONS FOR CICATRICIAL ENTROPION

GROUP 1.—Destruction of the individual affected hairs.

GROUP 2.—Reposition of individual hairs.

GROUP 3.—Complete removal of the lash-bearing area.

GROUP 4.—Removal of hairs from danger-zone.

(a) Removal leaving a raw surface at the lid margin.

(b) Raw surface filled by skin.

(c) Raw surface filled with mucous membrane.

GROUP 5.—Correction of faulty curvature of tarsus.

(a) By tension (method of Anagnostakis).

(b) By division of the tarsus from the conjunctival surface.

(c) By division of the tarsus from the anterior surface.

(d) By thinning the tarsus from the anterior surface.

The operations belonging to the first three groups have been sufficiently dealt with in the general summary of methods. We may pass, then, immediately to the operations of Group 4.

Arlt's Operation

Instruments.—Scalpel, Snellen's clamp, dissecting forceps, scissors, needles and needle-holder.

First Stage.—The surgeon makes an incision in the grey line throughout the whole length of the lid, of a depth sufficient to pass above the hair follicles, *i.e.* about 4 mm. deep.

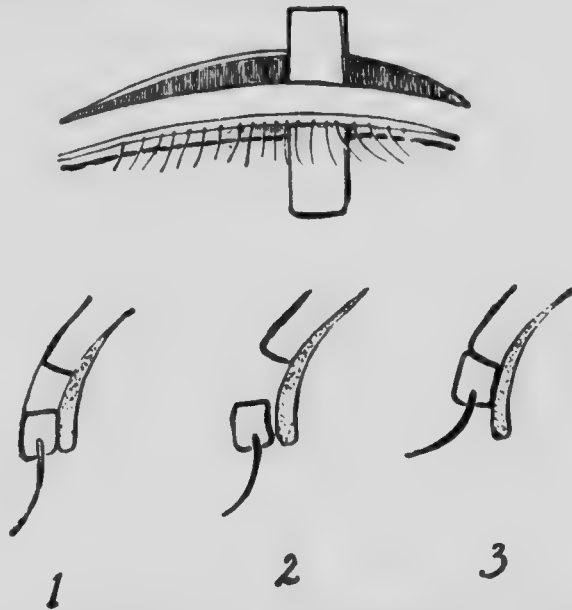


FIG. 46.—Arlt's operation. In the upper diagram the parts are shown at the end of the *third stage*. The lower sections represent the *second, third, and fourth stages*.

Second Stage.—He marks out on the lid a semilunar area, having its lower border horizontal, about 5 mm. above the free border of the lid, extending the whole length of the lid, and having its greatest height about 5 mm.

Third Stage.—He excises the skin within the semilunar incisions, leaving a large raw surface.

Fourth Stage.—He draws up the flap of skin which bears the lashes and stitches it to the upper margin of the raw surface.

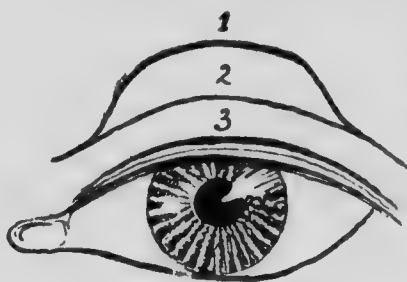
This method is fairly effectual as a means of lifting the cilia from the danger zone, but it entails a somewhat tedious convalescence, since the raw area which is left at the lid margin after lifting up the cilia is only slowly covered by epithelium by extension from the surrounding parts.

GROUP 4 (*b*).—The operation has been modified in various ways. Of these, Spencer Watson's (5) method deserves notice.

Spencer Watson's Operation for Complete Trichiasis

The same instruments are needed.

First Stage.—The surgeon makes an incision above the roots



of the lashes down to the tarsal cartilage, along the whole length of the lid, and, by a second incision in the grey line, separates a long bridge of tissue which contains all the hair follicles.



Second Stage.—A third (curved) incision is made, starting about 6 mm. from one extremity of the first, and, after enclosing an island of skin, ending at about 6 mm. from the opposite extremity; this, like the first, goes down to the tarsal cartilage. The tissues above the wound are lightly dissected back.

FIG. 47.—Spencer Watson's operation.
Second stage.

Third Stage.—Into the gap thus made the bridge of skin which bears the lashes is passed, over the island, and the parts

are secured in their new position by several points of suture. The lower margin of the island is united to the tissues of the lid which formed the posterior lip of the wound in the grey line, and forms the margin of the lid.

This modification is a great advance on the original operation of Arlt. No raw surface is left which has to be covered by

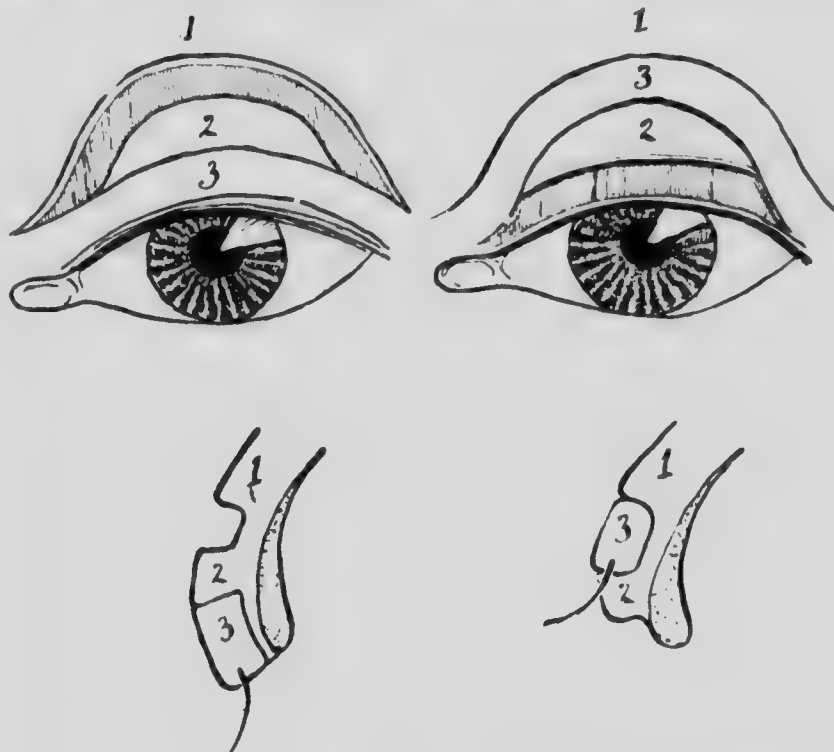


FIG. 48. - Spencer Watson's operation. End of second stage, showing the gap made by dissection above the island.

FIG. 49. - Spencer Watson's operation. Third stage, showing raw area left at lid margin.

the slow growth of epithelium from the edges, and, further, the tension of the stitches tends to evert the lower edge of the tarsus.

On the other hand, it has one serious disadvantage: the island of skin which is brought down from the lid to form the new lid margin remains skin in all respects, and gives rise to

much irritation of the eye by means of its fine downy hairs. This irritation may be a little less than that for which the operation was performed.

In some cases of entropion the deformity affects only one or other end of the lid; the lashes at the inner or outer canthus are incurved, while the remainder have a normal direction. In such it is specially tempting to choose the "partial" operation of Spencer Watson, but the surgeon must bear in mind the caution already given, and must be sure that the contraction has run its full course; if further contraction occur, it is certain that the deformity, though remedied at the time, will soon reappear, and the apparent success will be changed to obvious failure.

It has been implied in the preceding lines that the method is only suitable for those cases in which the canthal lashes alone are affected. A glance at the design of the operation will show the reason.

Spencer Watson's Operation

Instruments.—Snellen's clamp, dissection forceps, scalpel, scissors, needles and needle-holder. The Snellen's clamp, though not absolutely necessary, is a great convenience for these delicate operations, as it makes the field bloodless. It must be put on and screwed tight after the patient is anaesthetised.

First Stage.—The surgeon divides the affected area of the lid into two planes by making an incision in the grey line extending a little beyond the region of the inturned lashes. He gradually deepens it until it is about 6 mm. in depth, being careful to keep behind the hair follicles and close to the tarsal cartilage.

Second Stage.—In the anterior plane of the region thus divided two elongated flaps are marked out and separated—the lower, about 5 mm. in breadth in its whole extent, containing all the affected hair follicles, and having its base toward the

centre of the lid; the upper, a very elongated triangle, narrowing from its base, about 3 mm. wide, where it is attached near the canthus, to its apex, directed toward the middle of the lid.

The incisions which mark the flaps out may be made with sharp scissors more evenly than with a knife.

The flaps are attached to the body only by their bases, and therefore have very little vitality. The surgeon must take great care while making them not to bruise the tissues more than is unavoidable, and must notice that the flap which carries the lashes is attached towards the centre of the lid. If the flaps are cut in the reverse direction, the line of the lashes is broken and the deformity is accentuated.

Third Stage.—The flaps are now shifted; the lower is slid



FIG. 50.—Spencer Watson's operation (partial). The flaps are shown marked out at R and transposed at L.

upwards under the upper so that the lashes are lifted out of the dangerous position, and the upper fills in the gap left between the lashes and the free border. A suture at the extremity of each flap fixes them to their new bed. If necessary, other additional stitches may be used to hold the parts in position, but the delicacy of the flaps forbids the use of many. A dry dressing should be kept on for about four days, at the end of which the stitches may be removed.

This little operation has many good points in suitable cases, but it will be noticed that the tissue which is brought down to the edge of the lid is true skin, covered with down; and if there be any further contraction, this will be inverted and may be very irritating.

In the original description of his operation, in vol. vii. of the

Moorfields Reports, the flaps are cut so that the line of the lashes is broken; in the particular case which was thus operated on the lashes were in two distinct rows; the lower fell over and hid the break. Spencer Watson suggests the placing now usually adopted, and points out that by making the flaps long the operation may be extended to cases in which the whole lid is affected, thus anticipating the methods of Gayet and Vossius.

GROUP 4 (c).—If the surgeon desire to make a new margin to the lid, it is better to choose an operation such as that of Van Millingen (7), and called "marginoplasty." Van Millingen suggested that the lid margin should be reconstructed from mucous membrane taken from the patient's lip or some other convenient place. His method has, in turn, been modified by many surgeons, who have striven to make the implantation of the flap more speedy and secure: the special modification which we have found useful was suggested by Mutermilch (8).

Van Millingen's Operation (modification of Mutermilch)

For this the same instruments are necessary as before.

We may consider the procedure in four stages:—

First Stage.—An incision is made in the grey line of the lid-



FIG. 51.—Van Millingen's operation.

margin along the whole length, which therefore divides the tissues into two planes; the one in front should contain all the hair-bulbs, while the posterior consists of the tarsal cartilage and conjunctiva. The wound is cautiously deepened along its whole length until it is about 3 mm. deep. It forms a very

elongated oval, with pointed extremities. By small incisions at the extremities the wound is made rectangular, so as to offer a shape more easily filled by a mucous membrane flap. The surgeon must now carefully examine the posterior lip of the wound to see if any hair-bulbs have been left adherent to the tarsal cartilage. Each so found must be carefully dissected out.

Second Stage.—The next stage is that of placing the sutures to hold the flap in position, and this is the chief advance of Mutermilch's method. The flap to be transplanted is, as will be seen, completely separated from all its attachment, and therefore has a low vitality. If it is much wounded by needles, etc., it is not unlikely to die. On the other hand, unless it is



FIG. 52.—Van Millingen's operation. Mutermilch's modification and sutures.

kept firmly in contact with living tissues, it receives no nourishment, and cannot fail to succumb.

These two important points are both satisfied by the method now to be described. The surgeon passes a needle with a fairly long suture through the anterior plane of tissue and brings it out close to the skin at the anterior lip of the wound; then, reintroducing the needle close to the skin in the posterior plane, he brings it out on the conjunctival surface.

In this way a loop is left lying free across the floor of the marginal wound. Three or four such sutures are passed at equal intervals, about 8 mm. apart. To prevent the loops becoming entangled, it is well to pass under them a hook or a pair of forceps, which must then be entrusted to an assistant. All bleeding must be carefully stopped.

Third Stage.—The surgeon now marks out the flap of mucous membrane, usually on the lower lip of the patient. It must be about as long as the incision in the lip, and about 5 or 6 mm. broad. It is most easy to cut the two long incisions with a Beer's knife, running the point just under the mucous membrane, with the back turned against the tissues of the lip. The two short terminal incisions and the exsection can be performed with scissors.

The flap should be mucous membrane only. The surgeon spreads it out on his finger, with the mucous surface against the skin, and rapidly cuts off all the submucous tissue.

Fourth Stage.—The flap is now slipped under the loops of the sutures, so that the two raw surfaces of the flap and the wound are in contact. Then the ends of the sutures are drawn taut and the flap pressed firmly down into the bed prepared for it.

The sutures are not tied, but the ends fixed by collodion to the brow and cheek. A dry aseptic pad is bandaged over the eye, and should be left untouched for three days. At the end of that time the graft should have taken hold, and on the fifth day the sutures may be drawn carefully out.

The chief point in the success of the operation is the accurate adjustment of the flap to the raw surface. To favour this, all bleeding from the wound must have stopped before the flap be placed in position, or the blood collecting will raise the new graft from its bed.

Some operation such as the last is specially suitable for cases of deformity of the lid margin from old blepharitis.

Story's Operation for Entropion ("St Mark's Hospital Operation")

Story (9) employs the operation of margino-plasty (or, as Benson calls it, blepharoplasty) in a rather different form.

Instruments.—Snellen's clamp, von Graefe's knife, lip clamp, scissors, dissecting forceps, needles and needle-holder.

First Stage.—The surgeon having placed the clamp on the lid,

makes with the knife an incision in the grey line, along the whole length of the lid, splitting this so that all the hair bulbs are in the anterior layer. If any are left in the posterior, they must be removed by dissection. Story recommends that this incision should not be deep. Benson (10) lays stress on the great depth of the incision, which should be, he says, at least a quarter of an inch deep. In each case it must be the same depth throughout. No terminal incisions are made.

Second Stage.—A clamp is now applied to the patient's lip, and two parallel incisions are made through the mucous membrane with the knife marking out an area rather shorter than the lid wound. The ends of the two incisions are then joined by short converging cuts, so that the whole flap thus marked out is in shape a rectangle with an equilateral triangle at each end, the length being about five times the breadth.

Third Stage.—This flap is now dissected up with scissors and forceps, and laid, mucous surface down, on the surgeon's finger. From the deep surface he cuts away all the submucous fat and connective tissue.

Fourth Stage.—Story fixes the flap into the wound in the lid margin in the following way. He takes a silk suture in a fine curved needle and ties a knot on it at some little distance from the end; then he passes the needle through the flap from its superficial to its deep surface until the knot brings up against the mucous membrane.

This done, he enters the needle into one end of the wound and brings it out on the edge of the lid beyond the incision. A similar suture is used to secure the other end of the flap in place. The extremities being fixed, the edges are also secured by two or three points of suture to the corresponding edges of the wound.

When the clamp is taken off there is pretty free hæmorrhage, but this does no harm.

The flap, immediately after the operation, is quite white in colour; within twenty-four hours it becomes almost black, and in another twenty-four it has regained almost its normal tint (Benson).

Very recently, Dr Harrison Butler (11) has suggested an important modification of Spencer Watson's partial operation: he has found the chief drawback to be the fine hairs on the skin flap which is transported to the lid margin, and proposes to avoid this inconvenience in the following way. After cutting the flaps in the usual way, he truncates the upper triangular flap, leaving its base some two or three millimetres long. When the lash-bearing skin is sutured into position, this short flap is brought down and fixed between the apex of the former and the tarsal plate. By it the lashes are held away from the lid

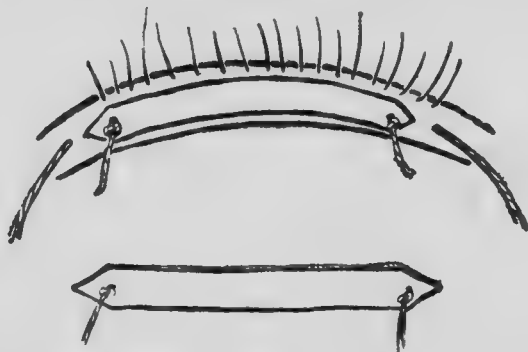


FIG. 53.—Story's operation. The lower figure shows the shape of the mucous membrane flap.

margin, but there is left a raw triangle, corresponding to the part abscised from the upper flap.

This is filled with a strip of mucous membrane.

GROUP 5 (*a*).—The operation of Anagnostakis (12) depends for its value on fixing the area of skin which bears the lashes up to the superior part of the tarsal plate; by the tension thus established the inversion is overcome, and the cartilage itself straightened to some extent.

Operation of Anagnostakis

Instruments.—Horn-plate (or Snellen's clamp), scalpel, dissecting forceps, scissors, needles and needle-holder.

First Stage.—An incision is made in the skin along the whole length of the lid, about 6 millimetres above the free margin.

By drawing on the skin, the wound is spread out so as to expose a large surface of the orbicularis palpebrarum.

Second Stage.—The exposed muscular fibres are excised, so that the tarsal plate is laid bare in almost its whole extent.

Third Stage.—This consists in the passage of the sutures. Three are usually sufficient. Each is passed first through the upper part of the tarsal plate, entering and emerging on the anterior exposed surface, and taking firm hold of the fibrous tissue, thence it passes through the skin below the primary incision, near the roots of the lashes. When the sutures are tied the lashes are drawn up and everted. At the same time the tension on the stitches somewhat corrects the faulty curvature of the tarsal cartilage.

Hotz (13) has published a slight modification of this operation. The sutures are passed through the skin below the incision, and, after perforating the tarsus, as in the original method, come out through the skin again above the incision. When they are tied, the wound is closed by the same sutures, which tend to evert the deformed cartilage.

Gifford (14) describes the same operation, but adds an incision through the cartilage from the conjunctival surface. This procedure is, as a matter of fact, not original, as Williams of Liverpool had published an account of an exactly similar procedure as far back as 1882 in the *Liverpool Medico-Chirurgical Journal*. He, later, gave up this method in favour of the plan which appears on another page.

Schneller (15), in cases of severe cicatricial entropion of the lower lid (a somewhat rare condition), has proposed the following treatment.

Schneller's Operation

Instruments.—Scalpel, dissecting forceps, needles and needle-holder.

First Stage.—The surgeon makes, at distances of 2 mm. and 6 mm. from the free border of the lid, two incisions through

the skin. The upper is rather longer than the region inverted, the lower is a little less. Their ends are connected by two short oblique incisions. Thus there is marked out on the skin an island.

Second Stage.—The skin surrounding the limiting incisions is slightly dissected up, without interfering with the skin of the "island."

Third Stage.—By means of sutures, the marginal skin is brought over the enclosed "island," which acts as a wedge to force the margin of the lid into the correct position.

This operation seems to have few advantages.

GROUP 5 (*b*).—The essential point of the method which form this group is the division of the cartilage from the conjunctival surface. In some instances, *e.g.* Williams' (16) method, the originator described it as a modification of an operation of another group, in this case of Anagnostakis'. The division of the cartilage, is, however, an essential point, and it seems best to take these operations in a separate class.

Williams' Operation

Instruments.—Scalpel, needles, needle-holder, small rubber drainage tube.

First Stage.—The surgeon everts the upper lid and divides the tarsus completely from side to side, placing the incision at the point where the curvature is most acute (usually about 4 mm. from the free margin). This allows the lid to retake its normal curve and the lashes to resume their normal position.

Second Stage.—The surgeon takes a needle and passes it, from behind forwards, through the lower piece of the lid, emerging on the skin just above the lashes; then passing it over a roll of gauze or a piece of drainage tube, he reinserts it through the skin and makes it take a firm hold on the deep structures, if possible of the tarsus. Three or four such sutures are passed; care must be taken that they have subcutaneous

courses of equal extent. The ends of the corresponding threads are tied firmly over a piece of small drainage tube, or, Williams advises, over a triangle of plaster, rolled up so as to make a roll tapering at each end and thickest in the middle.

By the tension of the stitches the tarsus is kept straight until the wound, which is converted from a line into a wedge-shaped space, is filled up by formative tissue. As this contracts the deformity in part returns; the skill of the surgeon is shown in producing at the time of operation just so much eversion as will be counteracted by the subsequent retraction.

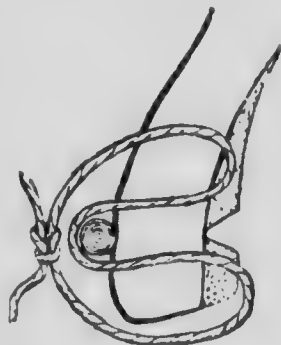


FIG. 54.—Williams' operation.

The advantages of the operation are its simplicity and the ease with which the effect can be adjusted. Further, the time of recovery is short:

no tissue is removed; and if the operation fail, the subject is no worse off than before, and a more radical procedure may be undertaken. Williams has great experience of this method in Liverpool, where trachoma is rife among the Irish poor, and finds it almost always successful. The disadvantage common to this and most other modifications of Anagnostakis' operation is that the cellular tissue of the lid is laid open to the invasion of microbes from the conjunctival sac.

Gifford (25) has described a method of operation which differs from Williams' only by the incision of a flap of mucous membrane from the lip. He uses a roll of cotton to make the tarsal incision gape, and states that if the flap is well pressed into the wound no sutures are needed to keep it in place.

Maher (26) describes a similar procedure, but sutures the flap in place. In cases of marked incurving, he advises in addition the division of the external canthus. G. E. Walker (28) performed this operation in 1885.

Lagleyze's (17) Operation is but little different from Williams' method.

Instruments.—Scalpel, needles, needle-holder. Five or six needles must be threaded on a single long thread.

First Stage.—The upper lid is everted so as to display the inner surface. The surgeon takes the needles in succession and passes them through the conjunctiva at the upper edge of the tarsal plate, and thence on along the cutaneous surface of the plate, to emerge at the free border of the lid behind the lashes; the needles are not drawn through, but remain, transfixing the tissues.

Second Stage.—The surgeon divides the tarsus freely with the scalpel, letting down on to the needles, which serve as a guide to show the required depth of the incision. It is necessary in this as in Williams' operation to divide the tarsal plate entirely from end to end.

Third Stage.—The needles are drawn through and the suture follows. The needles are then cut off, leaving in the lid loops of suture, in number one less than the number of needles. The ends of each loop are tied firmly over a piece of drainage tube. The tension produces a slight degree of ectropion, which corrects itself when the sutures are withdrawn seven or eight days later.

Green's (18) Operation is a modification of that of Burrow.

Instruments.—Green recommends a special knife, with a rounded end, dissecting forceps, scissors, needles and needle-holder.

First Stage.—The surgeon inverts the lid and makes an incision through conjunctiva and tarsal cartilage, about 2 mm. behind the openings of the Meibomian ducts, in the whole length of the lid.

Second Stage.—Replacing the lid in its usual position, he makes two incisions in the skin, the lower about 1.5 mm. above the lashes, and the upper about 2 mm. above this, and excises the intervening skin. The undivided orbicularis remains joining

the upper and lower segments, and separating the skin incision and the conjunctival.

Third Stage.—The sutures are inserted in the following manner. The surgeon makes the needle enter a little to the conjunctival side of the lashes and brings it out in the lower part of the skin wound. He then reinserts it at the upper part of this wound and passes it deeply upwards and backwards, grazing the anterior surface of the tarsal plate, and emerging through the skin about 10 mm. higher. Three such sutures are passed and are tied loosely.

Ewing (19) has devised a further modification.

He dissects up the conjunctiva before incising the tarsal plate, and completes the operation by suturing the flap of conjunctiva into the groove. He makes no skin incision, and inserts the sutures somewhat differently.

Insertion of Sutures in Ewing's Modification.—The part of the tarsus in connection with the hair-bulbs is turned forwards and the needle is passed into its cut edge near the orbicularis; it takes hold of the firm tissue and emerges again on the same cut surface; hence it is carried round the free margin of the lid, entered on the cutaneous surface in the line of the cilia and pushed upwards subcutaneously, to find exit about 5 mm. above the free margin.

Three such sutures should be passed, and tied over a roll of gauze.

Panas' Operation

Panas' (20) operation may be considered as in some sense holding an intermediate position between the methods just described and these following; it involves the division of the tarsal plate from the front, but the incision is carried through conjunctiva as well, and none of the tarsus is excised. The large wound is, by the division of the conjunctiva, thrown open to the invasion of micro-organisms.

Instruments.—Scalpel, dissecting forceps, scissors, needles, needle-holder, Snellen's clamp or metal spatula. (Panas advises

that the latter be employed, and the lid, thus supported, handed over to the care of an assistant, who at once keeps the tissues stretched, and prevents troublesome hæmorrhage. Snellen's clamp seems equally able to fill these requirements, and, if of full size, allows free access to the whole of the tarsal plate.)

First Stage.—An incision is made some 6 mm. or 7 mm. above the free border of the affected lid, through skin and muscle, down to the cartilage in the whole length of the lid.

Second Stage.—The surgeon takes the upper lip of the wound in the forceps and makes a dissection upwards between the orbicularis and the tarsus, exposing the whole of the surface of the latter above the first incision. Then, taking the lower lip in the forceps, he dissects downwards until he reaches the roots of the lashes; these must not be interfered with. It is im-



FIG. 55.—Panas' operation.



FIG. 56.—Panas' operation. Thilliez' modification.

portant to make this dissection extensive, since the result of the operation depends largely on the cicatricial contraction of the wound thus made.

Third Stage.—The surgeon makes an incision through the tarsal plate and the conjunctiva. This must be made at right angles to the anterior surface of the tarsus.

Fourth Stage.—The sutures are now put in. The surgeon takes a needle and inserts it at the lid margin, just behind the lashes; he passes it on, close in front of the tarsal plate, to the wound, where he brings it out; then, taking it again in the

needle-holder, he makes it perforate a part of the tarsal plate some millimetres above the horizontal incision and come out again on the anterior surface. When the ends of the suture are tied, the tarsus is bent into such a position that the lashes are everted. The ends of the suture are cut long and secured to the brow by collodion; three or four such sutures are needed. The tension on the threads brings the edges of the wound into contact, and no further stitches are required.

This method of operation is much used in France, but is comparatively little known in England.

There is one serious drawback to the operation: the lower part of the tarsus, completely separated from the upper, tends often to ride over it when the sutures are being tied, and thus the parts are fixed in a very faulty position. To remedy this defect, a slight modification of the operation has been suggested by Thilliez (21). He leaves in the middle a small part undivided, about 1 mm. or 1.5 mm. in width. This is sufficient to prevent the dislocation and shortening of the tarsal cartilage.

GROUP 5 (c).—This principle—the division of the tarsal cartilage—is a great advance on the methods which have been described hitherto, but its application in the last operations, *i.e.* from the conjunctiva, is not always satisfactory; the wedge of new-formed tissue which inserts itself during healing between the two parts of the cartilage contracts and allows the reappearance of the deformity. While, therefore, the method is often successful in mild cases, and at the worst does no harm, yet in the face of severe deformity we must seek a more thorough readjustment. The operations by the anterior route seek to fix the cartilage in a normal position and curvature at once, so that no cicatricial contraction is possible to destroy the effect of the surgeon's skill.

The device of attacking the tarsal cartilage from the anterior surface is apparently owed to Streatfield (22), of whose method a short description is to be found in the *Moorfields Reports*, vol. ii.

The operation is in all essentials that usually described as Snellen's, with the exception that Streatfield recommended that the strip of skin and muscle overlying the excised segment of cartilage should be removed with the latter, and that no stitches should be put in. He thought that the cicatricial contraction of the tissues would be more able to cause the required eversion of the lower margin if the wound healed slowly.

Streatfield's Operation

Instruments.—Desmarres' forceps (Snellen's clamp would be now substituted), scalpel, dissecting forceps.

First Stage.—The lid being held in the clamp, the surgeon makes an incision through skin and muscle, just above the roots of the lashes; this incision is deepened until it reaches the tarsal cartilage. A second incision is made about 2 or 3 mm. above this, joining it at the extremities, and, like the former, extending in the whole width of the lid, through the overlying tissues, to the tarsal plate.

Second Stage.—The incisions are then carried into the tarsal plate, obliquely, so that they join one another at or near the posterior surface of this structure, but do not interfere with the conjunctiva.

Third Stage.—All the tissues between the two incisions are removed, and the wound left to close by granulation.

It will be seen, on comparison with the method of Snellen, which is described below, how close is the resemblance of the two operations.

Snellen's Operation

Snellen modified Streatfield's operation as follows.

The same instruments are needed.

First Stage.—The surgeon makes an incision in the whole length of the tarsal cartilage (about 5 mm. above the lid margin, so as to be above the hair follicles) through skin and orbicularis, and by a slight dissection lays bare the tarsal plate at the region where the bending is most marked.

Second Stage.—He then makes two incisions through the tarsal cartilage, from end to end; these incisions are about two millimetres apart on the surface, but are directed towards one another, in the substance of the tarsus, so as to include a prismatic strip with the apex of the prism at the conjunctiva. This strip is excised with great care, so as to avoid any perforation of the conjunctiva. After its removal the tarsal cartilage is in two pieces, and the lower part is connected with the upper only by means of the conjunctiva.

Third Stage.—The surgeon now passes the sutures thus: taking a curved needle, he introduces it above the wound through skin and subjacent tissues, and through the tarsal cartilage, making it appear at the cut edge of this last. Then he passes the needle downwards and backwards through the lower fragment of the cartilage, so that it emerges on the conjunctiva, just behind the lid margin. Three such sutures are usually sufficient. When they are tied, the lower segment bearing the lashes is rotated on its own transverse axis, through an angle

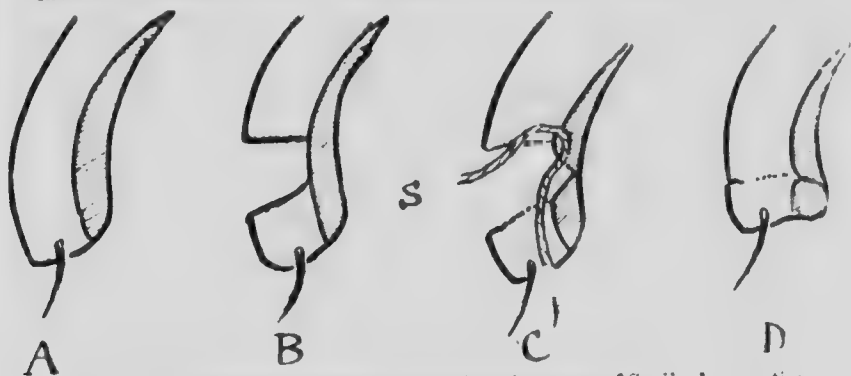


FIG. 57.—Diagrammatic sections of the lid in the stages of Snellen's operation.

equal to the apical angle of the prism excised, and the lashes, instead of pointing downwards, point forwards.

(Snellen advises a different mode of inserting the sutures; he passes the needle at once into the anterior surface of the tarsus without piercing the skin of the upper segment, and after bringing it out at the cut section, passes it onwards through the lower segment, in the cellular interval between the orbicularis

and the tarsus to the grey line where it emerges. The ends are tied, left long, and secured to the forehead. The path described in the text seems more simple, and equally efficacious.)

Knapp's Operation

Knapp's operation is very similar to this, and the first stage is identical.

Second Stage.—The surgeon makes two incisions parallel to each other and about 2 mm. apart, at right angles to the surface of the tarsal plate and through this, taking care not to injure the subjacent conjunctiva. The intervening strip of tissue is excised, and thus a gap of some breadth is left between the parts of the tarsus.

Third Stage.—Now taking a curved needle, the surgeon passes it through the skin above the wound and through the tarsal cartilage, to the cut border. Thence he passes it almost horizontally backwards through the lower segment of the lid, emerging on the conjunctival surface.

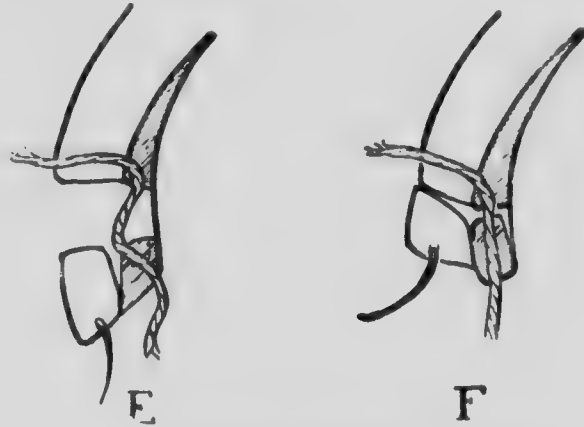


FIG. 58.—The last stages in Knapp's operation.

As in the preceding operation, three sutures are sufficient.

When they are tied the lower segment is rotated round its own axis through about 90°, and the hairs partake in this rotation.

A slight degree of shortening necessarily follows this operation,

but is not wholly disadvantageous ; trachoma is almost always combined with slight ptosis, as a result of the thickening and increase of weight of the affected lid, and this secondary deformity is remedied by the shortening.

We have never met with a case which could not be dealt with in a satisfactory manner by means of one of these latter operations. The trachoma commonly seen in London is mild in type. In Australia the disease is much more severe and surgeons there have had to adopt an operation which combines all the principles which have been mentioned.

Barrett and Orr's Operation (23)

First Stage.—The surgeon makes an incision along the whole length of the lid, just above the hair follicles, through skin and subcutaneous tissues down to the tarsus. By a slight dissection the anterior surface of the tarsus is exposed.

Second Stage.—If the tarsus is much incurved, a prism-shaped piece is excised, as in Snellen's operation. In most cases, apparently, this stage is omitted.

Third Stage.—By means of gut sutures the surgeon secures the edge of the skin bearing the lashes to the upper part of the tarsal plate. Three such sutures are sufficient. The tension of the sutures everts the lashes. The skin wound is closed with horse hair.

Fourth Stage.—A second incision is made in the grey line behind the roots of the cilia. This allows them to slide up somewhat on the tarsal plate, and lifts them still further out of the dangerous position at the lid margin.

Fifth Stage (Orr's modification).—The posterior layer of the lid, the tarsus, is sutured down to the upper margin of the lower lid by gut sutures, so that the tarsus is dragged downwards.

The experience of these surgeons is so great in this matter that we have much hesitation in criticising their methods ; it seems to us, however, that the raw surface left at the lid margin in this procedure is a disadvantage, and that with a constant

excision of a prismatic section it might be found unnecessary to make the incision in the grey line.

GROUP 5 (*d*).—Chronis (27), who, with his father, has had very large experience of trachoma and entropion, has devised a method of thinning the tarsal plate and making it supple.

He describes the plan in seven stages :

First Stage.—He divides the outer canthus freely.

Second Stage.—He makes an incision about 3 mm. above the lashes through the skin only from opposite the punctum lacrymale, to join the first incision beyond the outer canthus. He dissects the skin back to a level above the top of the tarsal plate.

Third Stage.—He removes that part of the orbicularis which covers the tarsal plate and also Horner's muscle.

Fourth Stage.—He shaves off the outer surface of the exposed tarsal plate, until it is sufficiently thin and supple.

Fifth Stage.—He passes the sutures: those that affect the lid through the lid margin from without inwards without touching the hair bulbs, and then horizontally through the orbital fascia, above the tarsal plate; those that affect the canthotomy uniting the conjunctiva to the skin.

Sixth Stage.—He ties the sutures, producing an over-correction.

Seventh Stage.—He makes in the grey line an incision about 1 mm. deep in the whole length. The skin wound is left unsutured.

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CHAPTER IV

OPERATIONS ON THE LIDS—*continued*

ECTROPION

ECTROPION—eversion of the lid—is due to one or other of several causes, to paralysis of the orbicularis, to displacement of the lid by some swelling, innocent or malignant, or to cicatricial contraction of the surrounding parts.

Paresis, or paralysis, of the orbicularis is one of the most important causes of ectropion of the lower lid. In Bell's paralysis the loss of tone of the muscle allows the lid to fall away from the globe, and to expose the inner conjunctival surface to a greater or less extent. Between the lid and the globe there is left a large space in which tears collect: when it is full, the tears cannot reach the puncta lacrymalia, and run over the face, causing discomfort and often giving rise to eczema. Nor is this all; the lower part of the cornea is exposed to injury from the absence of the normal protection, and, after a time, often becomes ulcerated and nebulous. Usually the tendency of the paralysis is to recovery, and we should not be eager to undertake surgical interference; but if, after reasonable waiting, the symptoms still continue, something must be done. If the recovery have been nearly complete, it will be sufficient to make easier the outflow of the tears. This will prevent further lacrymation, which is the chief discomfort.

Our object is easily attained by incising the lower canaliculus on the inner surface of the lid in such a way that it is

converted into an open gutter, down which tears can easily escape from the lacus lacrymalis into the sac. The little operation will be described later.

Should the ectropion be rather more, sutures may be inserted to correct it.

SNELLEN'S (1) SUTURES FOR ECTROPION

The surgeon takes a stout silk thread, armed at each end with a needle, and passes one needle through the most prominent part of the everted conjunctiva and underlying tarsal cartilage, thence onward subcutaneously to the lowest fold of the lid. The fellow needle is passed in a similar course about 8 mm. away from the first. One such suture is required at each extremity of the middle third of the lid. When the ends are drawn taut, and tied over a piece of drainage tube, the lid is pulled back into a normal position. The sutures should remain *in situ* for at least a week.

These methods of treatment are only of avail in very slight degrees; if the sutures fail, the lid may often be drawn back into position by cauterising the internal surface with the galvano-cautery; the point must be drawn along the whole length of the lid near the margin. The contraction of the small scar corrects slight displacement.

If these measures prove insufficient, or if the deformity is from the first clearly more than such means can correct, a more drastic procedure must be used. It must be borne in mind that continued eversion lengthens the lid margin. Any operation for its remedy must therefore shorten it to its former length. Various methods for shortening and raising the lid have been proposed. Of these one of the best is that devised by Kuhnt (2).

Kuhnt's Operation

Instruments.—Scalpel, or lance knife, dissecting forceps, needles and needle-holder.

First Step.—The surgeon estimates the amount of shortening necessary to replace the lid, and marks out on the conjunctival

surface a triangle, whose base at the lid margin is equal to this amount, and whose apex is just below the lower border of the tarsal cartilage. The lateral incisions pass through both conjunctiva and tarsus.

Second Stage.—The operator makes an incision in the grey line along the base of the triangle, and removes that part of the tarsal plate and conjunctiva within the area delineated, leaving the superjacent tissues intact.

Third Stage.—The margins of the wound are brought together by several sutures passed from the skin surface, which must have a firm hold on the tarsal cartilage. One should be placed near the margin of the lid, and care must be taken to keep the two parts of the tarsus in line, so as to preserve the line of the lid smooth and even.

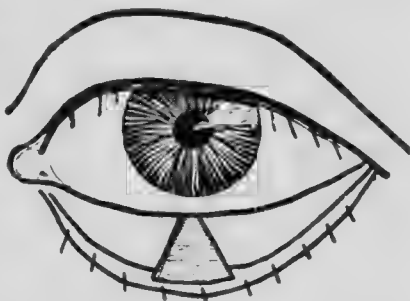


FIG. 59.—Kuhnt's operation. *Second stage.*

The immediate result is to produce an ugly fold of skin opposite the wound, but this soon disappears. The only danger is that the sutures are not sufficiently firmly placed: unless they are secure, they may cut out and allow the wound to gape and the deformity to reappear.

In this operation the redundant skin and muscle are left unattacked. Dimmer (3) describes a modification of Kuhnt's operation, which is designed to avoid this defect.

Dimmer's Operation

First Stage.—Having estimated the amount to which the surgeon desires to shorten the lid, he makes an incision of that length, just external to the external canthus and in the same horizontal line, through the skin; from each end of this he makes another downwards, so that the three enclose an isosceles triangle; the skin within this triangle is excised.

Second Stage.—From the outer canthus inwards he then splits the lid by an incision in the grey line, until he has passed the middle of the margin.

Third Stage.—Next the surgeon excises a triangle of tarsal

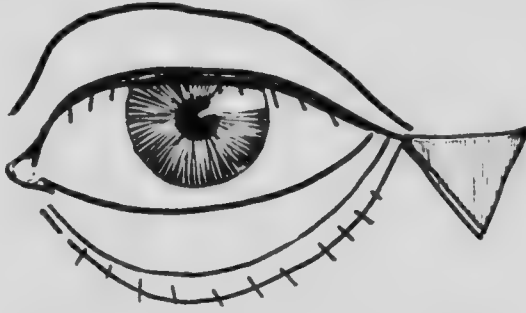


FIG. 60.—Dimmer's operation. *End of first stage.*

cartilage equal in size to the triangle of skin which was removed in the first stage, and with it, necessarily, the conjunctiva to the same amount. The excised triangle has its base at the



FIG. 61.—Dimmer's operation. *End of third stage.*

lid margin, and its inner border corresponds with the inner extremity of the splitting of the lid.

Fourth Stage.—The marginal skin with its hair follicles is removed from the lid near the external canthus, and the whole lid is drawn outwards, so that the gap in the tarsal plate is closed and the external triangle is covered by the skin of the

lid. The parts are secured in the new position. The skin must be united first, and afterwards deep sutures must be passed to hold the edges of the tarsus together.



FIG. 62.—Dimmer's operation. *Final stage.*

Argyll Robertson (20) described an operation which has the great advantage that the cicatrization of the wound tends to pull the parts into closer apposition.

First Stage.—He makes an incision through the skin of the lid in the outer third, at about 2 mm. from the lid margin, and continues it upwards for about 12 mm. He then turns it

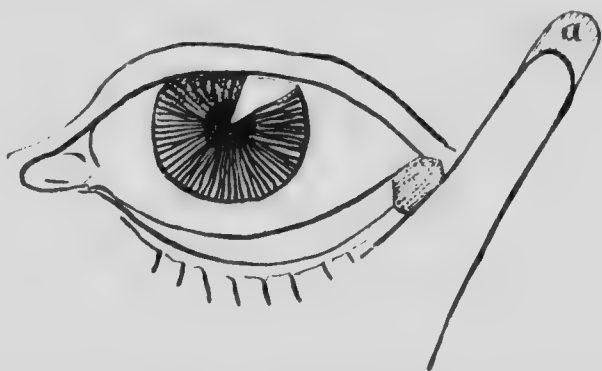


FIG. 63. Argyll Robertson's operation: *end of second stage.* The shaded area (*a*) shows the part that will be covered when the lid is pulled into place by the flap—this area will be dissected off.

in a rounded extremity, and carries it downwards again, about 6 mm. from the first incision for some 3 cm., diverging a little towards the lower end.

The flap of skin thus outlined is dissected back.

Second Stage.—He then removes from the lower lid, at a distance of some 3 mm. from the canthus, a V-shaped piece

containing all the thickness of the lid. Argyll Robertson recommended that this piece should be rather smaller than the surgeon's estimate of the requirement; it is easy to remove more if necessary.

Third Stage.—He grasps the flap and draws the lid up and outwards until the edge of the lid is reformed. The flap now overlies a certain amount of skin; the overlap is outlined by means of a knife and dissected away. The flap is now fixed by sutures as required.

Tweedy has described an operation for shortening and raising the lid; although it was intended for the relief of certain cases of cicatricial ectropion, it may be used with advantage in some severe paralytic forms.

It will be described, however, under the head of cicatricial ectropion, for which the author designed it.

SENILE ECTROPION

In old people persistent blepharo-conjunctivitis often gives rise to a very unsightly form of ectropion. The marginal conjunctiva is thickened and everted as a prominent red fold. The heavy tissues overtax the orbicularis and the lid falls away from the globe.

The muscle is not really weakened, and, at all events in the early stages, the tone can be restored if the conjunctiva become again normal. Astringents are occasionally able to cure the deformity; more commonly, unfortunately, the disease of the lid is of such standing that it is not amenable to such mild forms of treatment. Under these circumstances the surgeon will have to consider the best means to relieve the defect.

The application of the galvano-cautery to the everted conjunctiva, either in one line along the whole length of the lid, or preferably in three or four short lines across the fold, will give rise to a slight degree of cicatricial contraction sufficient to roll in again the margin to its normal position.

In the worst forms, however, this does not suffice, and some more extensive procedure must be adopted.

In such cases as we are considering, the surgeon will find, if he examines the lid, that the conjunctiva is almost healthy near the cul-de-sac, while the marginal portion, perhaps rather more than half, is thickened, reddened, and everted: this is the diseased area.

Freeland Fergus's Operation

Freeland Fergus (4) recommends excision of the affected part.

Instruments.—Scalpel, scissors, dissecting forceps, needles and needle-holder.

First Stage.—The surgeon makes two incisions, enclosing the diseased fold from end to end of the lid; the outer incision is placed at the junction of the conjunctiva and skin, and the lower at the junction of the healthy and diseased area.

Second Stage.—He picks up the lip of the healthy conjunctiva below the lower incision, and dissects up the mucous membrane to the cul-de-sac.

Third Stage.—He then excises rapidly the diseased tissues, and closes the wound left after their removal by several points of suture.

In this way the lower healthy conjunctiva is brought up to the skin and forms a new margin to the lid. Fergus states that it is rarely if ever necessary to shorten the lid or deal with the skin in any way.

Terson's Operation

Terson (5), in similar cases, has not found the excision of the conjunctiva adequate. He combines with it removal of a small area of skin, and thus has devised an operation which deals efficiently with these severe forms.

Instruments.—Scalpel, scissors, fixation and dissecting forceps, needles and needle-holder.

First Stage.—The surgeon ablates the hypertrophied mass of the conjunctiva, taking care to leave the tarsus untouched. If the excision be made too deep, he will run a great risk of causing symblepharon or trichiasis.

No conjunctival sutures are to be put in; the wound heals with less ease and regularity if any have been inserted.

Second Stage.—He now marks out, just external to the outer canthus, a triangle of skin, having one side vertical, divided

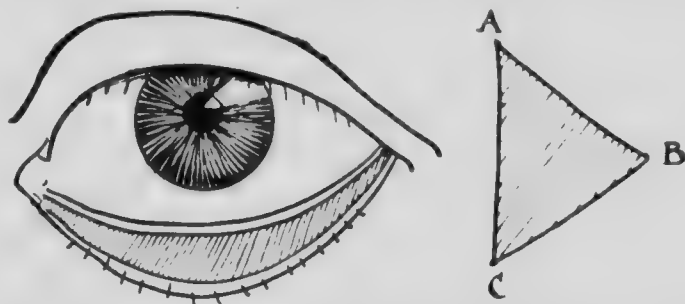


FIG. 64.—Terson's operation. *Second stage:* the shaded triangle A, B, C represents the skin removed. The shaded area on the lid shows the raw surface left after removal of the hypertrophied conjunctiva.

equally by the line of the palpebral fissure, and the apex external.

The size and position of this triangle is shown clearly in the diagram. The area of skin within the triangle is removed.



FIG. 65.—Terson's operation. *Final stage.*

Third Stage.—The raw surface is covered by drawing the surrounding parts together and securing them in their new position by several points of suture.

The tension on the lower lid overcomes the eversion. The whole procedure is short, lasting only about five minutes, and is therefore well adapted to the requirements; prolonged

anæsthesia is always undesirable in old people, and it may be dispensed with, if necessary, for so short a proceeding.

When the hypertrophy of the conjunctiva is small, none of this membrane needs excision; the form and position of the triangle of skin may be altered with advantage; it should be placed higher and somewhat obliquely. This modification is owed to Obarrio.

MacCallan (22) has described an operation for a form of ectropion of the lower lid in trachoma, similar to the hypertrophic variety just mentioned. In such patients, he says, "the tarsal cartilage is displaced so that its normal vertical axis comes to lie horizontally, immediately under the conjunctiva. Between the attachment of the cartilage to the orbito-tarsal fascia and the globe, the conjunctiva is usually found to be prominent, cicatrised, and thickened."

First Stage.—The surgeon makes a horizontal incision through the conjunctiva throughout the length of the lid, about 5 mm. from the margin, *i.e.* at the point at which it is desired to make the new fornix. From each extremity of this incision vertical slits are made at the canthi almost to the lid margin.

Second Stage.—The conjunctiva is then dissected up over this area.

Third Stage.—The tarsal plate and as much of the hypertrophic conjunctiva below the first incision as is requisite is removed.

Fourth Stage.—Sutures are passed from the skin, taking both lips of the conjunctival gap, and passing through the skin again. They are tied loosely on the skin surface.

THE TREATMENT OF CICATRICIAL ECTROPION: BLEPHARO-PLASTY.

The treatment for cicatricial ectropion is to a large extent similar to that required for the reconstruction of a lid after the removal of a malignant growth, and operations for the two conditions are often grouped together under one name—blepharo-plasty.

There are two main groups of these operations, which will have to be dealt with separately, and each of these is subdivided into several minor divisions. The chief point of distinction is the origin of the new lid; in some this is made from the neighbouring parts; in others the gap left after reposition of the affected lid is filled by grafts taken from a distance.

Blepharoplasty, with all other plastic surgery, has undergone great development during the war. Plastic surgery has been called upon to undertake tasks which would have been considered impossible in former times. The building anew of features destroyed by shell bursts or bullet wounds, the transplantation of bone, cartilage, and muscle, as well as of skin—these things have been accomplished in a way that is the admiration of all surgeons.

Fortunately, it is unlikely that any man of this generation will be called upon again to exercise this skill to anything like the same extent, and it is probable, therefore, that the more extensive operations will never be practised in civil life, and that the ophthalmic surgeon's largest task will be to repair, after a burn, one or perhaps both lids of one eye, or to replace a lid destroyed by a malignant growth.

The extraordinary operations which Major Gillies has so skilfully planned and carried out are, therefore, not likely to be imitated for some time at least, since the necessity will rarely arise.

We have, therefore, left this section in the same shape as that of the preceding edition, because many of the methods are still applicable and, indeed, the best adapted to the minor lesions which are likely to offer themselves; and we have not entered into a description of the larger reconstructive plastic measures which Major Gillies devised. We have inserted his method of "outlays," since this is of great value in any dealings with cicatricial ectropion.

The experience of the war has gone to prove the value of Thiersch grafts in all cases of severe ectropion; and there is

no doubt that when the neighbouring tissues are not available, these grafts are the best possible substitute. They have one small disadvantage in that if they are taken from a surface which bears hairs, these hairs may reappear in the new situation where they are not wanted. But this is a small matter, and the choice of position from which grafts may be taken is so large, that when this fact is known, such a mishap can be avoided.

But when the neighbouring tissues are sound, they will serve better, in many cases, for the repair of a whole or part lid.

In the first edition we laid some emphasis on Hotz's (6) views on the relief of cicatricial ectropion, and we endorsed his reasoning. There are, he says, in the *American Journal of Ophthalmology* for 1903, three points in these operations which are usually insufficiently regarded: the proper division and fixation of the flaps, the choice of suitable material from which they are to be cut, and, lastly, the shortening of the everted lid margin.

It is useless, he says, to cover a large raw surface with a simple skin graft. The contraction of the graft will, in all probability, bring about a second eversion within a very few months. The surgeon must, therefore, employ two flaps—fixing one to the lid in such a way that the contraction of the other cannot exercise any pull on the lid margin. The raw surface, therefore, must be covered by two flaps—one for the lid and one for the neighbouring area.

As to the tissue from which the flap for the lid is to be taken, nothing is so suitable, says Hotz, as the cicatricial skin; this is thin, supple, and hairless, and is nearly always available.

From personal experience of Hotz' methods, we can endorse all that is said here.

Adjemian (7) gives as his opinion, based on many years' experience in Constantinople, that Thiersch grafts are applicable to all cases of ectropion due to cicatricial contraction, but at the

same time lays down certain rules which it is essential to observe. Some of these require modification in view of Major Gillies' work, but when formulated they were of great value. The chief rules are :

1. The relaxation of the everted lid must be complete.
2. All cicatricial bands must be excised from the area which is to form the bed for the flap.
3. The bed must be enlarged as much as possible by traction through sutures, passed through the lid margin, and secured to the neighbouring parts by collodion.
4. The flap used to cover the surface must, if possible, be single ; a mosaic of grafts is doomed to failure.
5. The edges must be very accurately adjusted, and care must be taken to prevent their rolling in.

It will be seen that all these points are dealt with in Major Gillies' method, though the bed is enlarged by the pressure of the mould, which also prevents the edges of the graft from becoming inturned.

Not all surgeons have found these plans of service. Dupuy-Dutemps, for example (*Archives d'Ophthalmologie*, vol. xxi.) considers that the transplanted graft has been a failure in these operations, and expresses his preference for a modification of Fricke's operation, which he describes. The modification is only in the region from which the skin flap is to be taken. Dutemps advises the surgeon to take a fold of skin from the upper lid, which is usually redundant, to fill any gap in the lower.

Cirincione and his pupil Calderaro (8) also have found Thiersch grafts unsatisfactory, and are inclined to counsel their entire abandonment. They have come to the conclusion (*La Clinica Oculistica*, 1905) that some modification of Fricke's operation is the best where it can be carried out.

Valude expresses a similar opinion.

As a general rule, it is advisable to unite the margins of the lids (tarsorrhaphy), to oppose the contraction of the lids during

the later stages of healing, which would otherwise reproduce the deformity.

OPERATIONS FOR ECTROPION

- A. By flaps from neighbouring parts.
 1. By pedunculated flaps.
 2. By displacement of surrounding parts.
 - (a) Superficial (Wharton Jones, Dieffenbach, Burow).
 - (b) Deep (de Vincentiis).
- B. By grafts from a distance.
 1. Containing all parts of the skin.
 - (a) Pedunculated. Tagliacotian operation.
 - (b) Wolf's grafts.
 2. Epidermic or Thiersch grafts.

GROUP A, 1.—*Pedunculated flaps*.—When the deformity to be corrected is small, and the localised loss of tissue not extensive, the method of pedunculated flaps is usually successful. The surgeon will have to note certain points in the procedure which are of importance in gaining the best result. The position of the flap must be selected in normal or approximately normal skin: if the vessels are few the nutrition of the transplanted skin is small, and it may be insufficient to tide the flap over the first twenty-four hours, before the vascular supply from the bed is able to nourish the tissue. The flap must therefore be cut so that the general flow of blood is from the base towards the extremity, and the base must be placed so that the turning necessary to place the flap in its new bed is not so great as to interfere with the vascular supply.

The surgeon must recollect, further, that the flap will undergo considerable contraction after it has been separated: it must therefore be larger by about one-third linear measurement, *i.e.* nearly double the area of the space to be filled. The base of the flap should contain the subcutaneous tissues, but the body may be advantageously formed of skin only.

The direction in which contraction will take place must also

be taken into account, and utilised to prevent a recurrence of the deformity. Thus, if the upper lid be under treatment, the base of the flap will be placed below the canthus and the force of contraction thus used to prevent a second ectropion. If, on the other hand, the lower lid is under repair, the base of the flap will be upwards above the canthus.

The type of this form of operation is the original method of Fricke; many minor varieties have been described by Hasner, Dupuy-Dutemps, and others, but the main principle is that of Fricke, and the variations are simply local.

Fricke's Operation (9)

Instruments.—Scalpel, dissecting forceps, scissors, pressure forceps, needles and needle-holder.

First Stage.—The retracted lid is freed by an incision through the scar, or, if this is well localised, the whole scar may be circumscribed by two hemielliptical incisions, and removed. The margin of the affected lid must be stretched away from the



FIG. 66.—Fricke's operation. *Second stage.*

attached border, so that the wound is made as large as possible. Any deep bands of scar tissue should be excised as completely as the surgeon can, and all bleeding stopped.

Second Stage.—The flap for transplantation must next be

marked out; its position will vary with the defect to be corrected. Fricke described his operation for the relief of ectropion of the upper lid, and we will follow here his original description.

The surgeon makes two incisions on the skin of the temporal region, containing between them an elongated pedunculated flap, larger in each dimension by one-third than the space to be filled. The inner (or anterior) incision should join the primary relaxing incision, or this latter must be prolonged to meet it. The upper ends of the two incisions are rounded

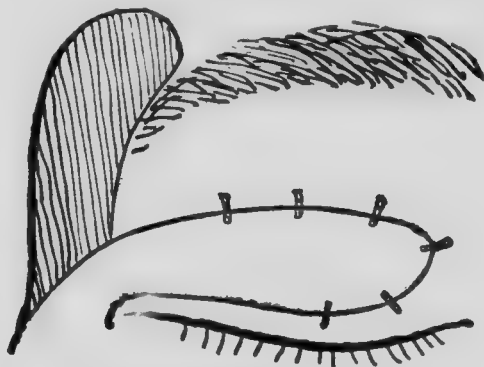


FIG. 67.—Fricke's operation. *Fourth stage.*

into each other; the lower ends diverge slightly and are continued below the level of the canthus, the outer rather further than the inner, so as to allow rotation of the flap on its base with the greatest ease.

Third Stage.—This flap is now to be dissected up; the body should contain skin only, but as the surgeon approaches the pedicle he will be well advised to take up the subcutaneous tissues also. All bleeding must be stopped.

Fourth Stage.—The flap is twisted on its base and secured into the gaping wound of the lid.

Some surgeons make a considerable interval between the first and second stages; not content with waiting until the bleeding is stopped, they wait twenty-four hours before applying the flap to its bed; some even wait until the bed is

covered with granulations. This seems unnecessary; it is enough to make sure that there shall be no effusion of blood or serum to separate the flap from its new attachments.

Dupuy-Dutemps has described a modification; to repair a defect of a lower lid, he cut a flap like that of Fricke from the loose skin of the upper.

When one lid is completely destroyed, Cirincione (23) has modified the method in the following way. He splits the remaining lid, and attaches the tarso-conjunctival layer to the conjunctiva of the fornix of the lost lid, and applies to the raw surface of the tarso-conjunctival plate a pedunculated flap cut after the manner of Fricke.

This operation, it will be seen, combines the principles of Groups A (1) and A (2).

Tweedy's operation (10), which has been already mentioned under the head of senile ectropion, may also be regarded as, in some sense, a modification of Fricke's.

Tweedy's Operation

Instruments.—Scalpel, scissors, dissecting forceps, needles and needle-holder; pressure forceps may be added, but are not often required.

First Stage.—The surgeon makes an incision downwards and outwards from the outer canthus, following the normal lines of the skin, about 30 mm. in length. He then makes a second incision about 8 mm. away from the first, starting at the border of the lid, and taking a course parallel to the first.

Second Stage.—He then makes an incision through the conjunctiva and tarsus, starting at the upper extremity of each of the two previous incisions and converging to the lower cul-de-sac. All the mass of tissue between these incisions is dissected up to form a flap, adherent only by its base at the lower and outer end. The pedicle is cut long as described, to allow of the twisting which is to follow. The

conjunctiva may be dissected up and used to lengthen the flap if necessary.

Third Stage.—From about the middle of the lower limiting incision of the flap a third incision is made, through skin and

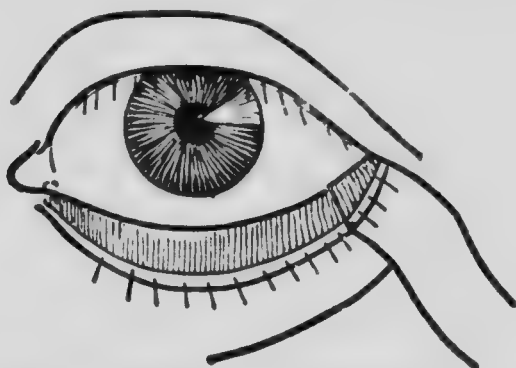


FIG. 68.—Tweedy's operation, showing the incisions.

orbicularis, down to the orbital fascia, so that the lid can be raised into place. Into the gap thus left the flap is turned and implanted; all parts are secured by stitches.

A method essentially similar to that of Fricke is that of

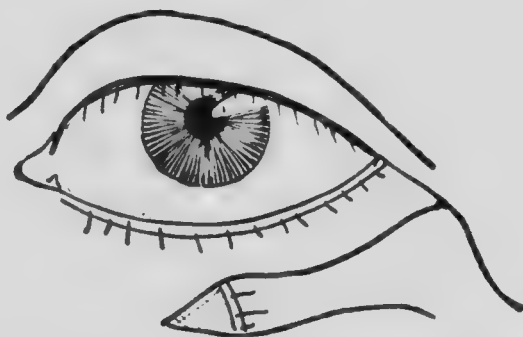


FIG. 69.—Tweedy's operation. Transposition of the flap.

Businelli and Badal. These surgeons suggest that a small defect of the lid may be filled by taking a bridge flap. Badal fills a gap in the lower from the upper lid, Businelli takes a flap from above the brow to repair the upper. It is practically a double Fricke flap united to its fellow in the centre.

Goyanes (11) has recently made an ingenious suggestion for those cases where the eyebrow is destroyed by scar as well as the upper eyelid. He cuts a flap from the forehead of the opposite side, taking in the upper half of the opposite eyebrow, with a long pedicle over the base of the nose.

The eyelid is replaced in position by dissection and the flap brought across to fill up the gap. The secondary loss is covered by bringing down the frontal skin.

Denonvilliers (12) proposed to raise the external angle of the eye, when this was drawn down and everted, by a procedure which he termed the substitution of flaps. The operation is limited in range, but in favourable subjects is most efficient.

Denonvilliers' Operation

Instruments.—Scalpel, dissecting forceps, pressure forceps, needles and needle-holder.

First Stage.—The surgeon makes an almost horizontal incision below the everted outer half of the lid, and carries it on to a point about 12 mm. below and external to the canthus.

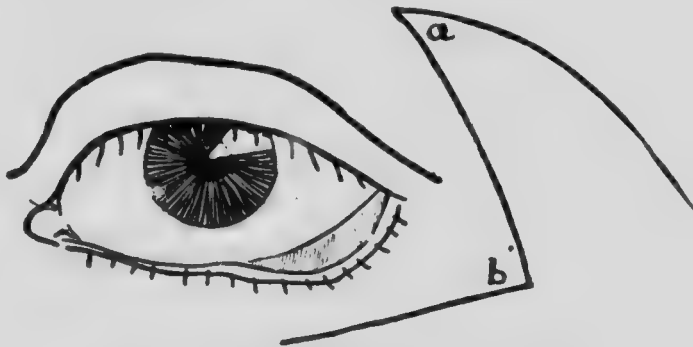


FIG. 70.—Denonvilliers' operation. *Second stage.*

From this point he makes a second curved incision upwards, which reaches the brow about opposite the canthus. In this way he marks out a triangular flap, with the base towards the eye and the apex towards the temple.

Second Stage.—From the point where the first flap touches the brow, he makes a third incision downwards and outwards, which ends at a point opposite to and about 2 cm. from the external canthus. This incision, with the upper incision of the first flap, marks out a second flap placed in the reverse direction.

Third Stage.—Both these flaps are dissected up, so as to

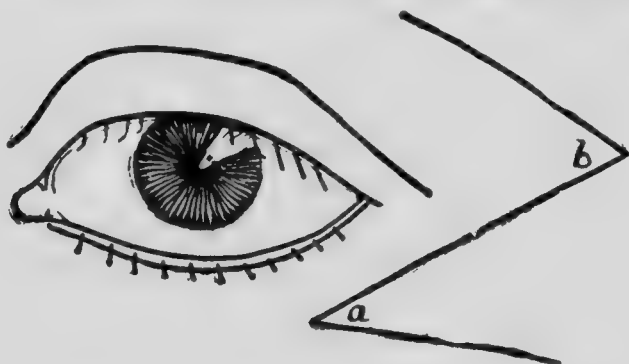


FIG. 71.—Denonvilliers' operation. *Third stage*: flaps transposed.

mobilise them, and they are then transposed and fixed in position by numerous stitches. A total tarsorrhaphy will usually be required.

Richet (13) has modified this operation so as to give it greater scope. It is still only applicable to cases of ectropion affecting the outer canthus only.

Richet's Operation

First Stage.—The surgeon makes an incision round the everted canthus, and, by dissection, frees the lid from the scar tissue which holds it. This leaves a raw area of an irregular meniscoid shape.

Second Stage.—Having thus replaced the canthus into its normal position, the surgeon sews the lids together, performing total tarsorrhaphy.

Third Stage.—From the external angle of the raw surface

the surgeon makes a second incision, passing downwards and outwards for about 2 cm., and from the middle of this a third, which passes upwards and outwards. These two



FIG. 72.—Richet's operation. *Third stage*: the eye is represented open, but would usually have been closed by tarsorrhaphy.

incisions limit two triangular flaps, which must now be raised.

Fourth Stage.—The upper of the flaps is turned inwards to

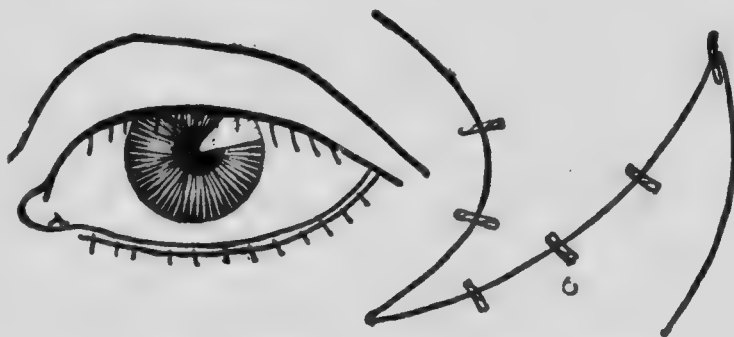


FIG. 73.—Richet's operation. *Final stage*: (without tarsorrhaphy).

fill the gap left by the dissection in the first stage; the secondary gap is filled by the larger lower flap.

GROUP A, 2 (a).—The operations "by sliding" are rarely satisfactory except when the defect to be filled is small. If

there is a localised contraction from a scar on the face below the lid, it may be possible to remedy the deformity by means of Wharton Jones' (14) (or the V Y) operation.

Wharton Jones' Operation

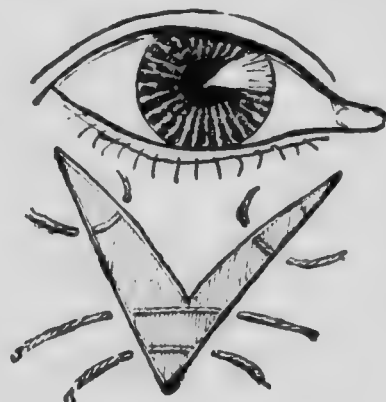
Instruments.—Scalpel, dissecting forceps, scissors, needles and needle-holder.

First Stage.—The surgeon makes two incisions, one from each end of the lid, following, as far as possible, the lines of



A

FIG. 74.—Wharton Jones' operation.
First stage.



B

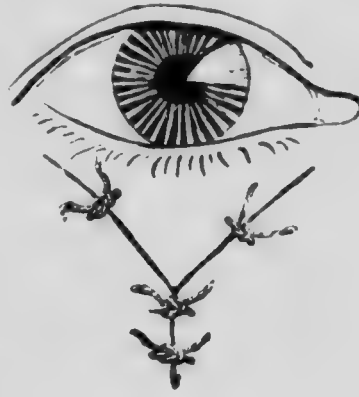
FIG. 75.—Wharton Jones' operation.
End of second stage.

the skin folds, and converging to a point below the scar. The incisions include the scar.

Second Stage.—He then dissects up the contained skin freely, until the lid can be replaced easily in its proper position. All obvious bands of scar should be excised from the subcutaneous tissue. When the lid is pushed up into place a raw surface is left below the apex of the V.

Third Stage.—The lateral parts are now brought together and secured so as to cover this raw surface; the resulting scar is Y-shaped.

Unless the defect for which the operation is undertaken be very small, it is advisable to scarify the edges of the lids and unite them temporarily. The palpebral fissure may be opened again in a few weeks.



C

FIG. 76.—Wharton Jones' operation.
End of operation.

When a considerable part of the lower lid is invaded by a new growth, or destroyed by scarring, a more extensive sliding operation was recommended by Dieffenbach (15).

Dieffenbach's Operation

Instruments.—Scalpel, dissecting forceps, scissors, pressure forceps, needles and needle-holder.

First Stage.—The surgeon marks out, on the lid, a triangular area having the base at the margin, and enclosing all the new growth or scar within the three sides. If the conjunctiva be unaffected—and this is an essential for the perfect success of the operation—the overlying diseased tissues are carefully dissected away, leaving the mucous membrane.

Second Stage.—The surgeon then marks out on the face, on the outer side of the raw area, an oblique parallelogram, having as one side the external side of the triangle, and another bounded by an incision prolonging horizontally the base of the triangle, and of equal length. A third side is parallel to the first, and the fourth is left continuous with the cheek.

This parallelogram of skin is dissected up.

Third Stage.—It is then slid over and secured so as to fill

the triangle; it necessarily leaves an area equal to the original triangle uncovered on the cheek, and this is left to granulate.

If the operation were performed at the present time, the raw surface would probably be covered by grafts.

GROUP A, 2 (b).—The operation of De Vincentiis (16) is of more value, but is limited in application to new growths affecting not more than the inner third of the lid.

De Vincentiis' Operation

Instruments.—Curved, blunt-pointed scissors, scalpel, dissecting forceps, pressure forceps, needles and needle-holder.

First Stage.—The surgeon excises with knife or scissors all the part affected.

Second Stage.—He then prolongs the palpebral fissure out-

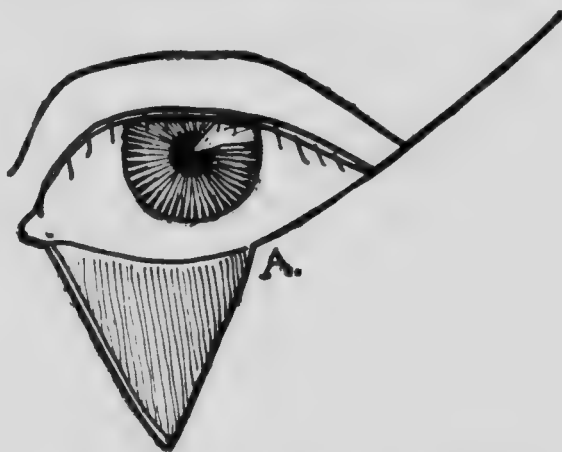


FIG. 77.—De Vincentiis' operation. *Second stage.*

wards, directing his incision a little upwards, for about 20 mm., and frees the outer part of the lid, by dividing, subcutaneously, the orbital ligament with scissors.

Third Stage.—Then the remainder of the lid is brought along to fill in the gap, and is secured in the new position.

This method is said to be very satisfactory in properly selected cases.

It seems not improbable that in cases of malignant disease these operations will be superseded by the use of radium, which has already proved of great value; when successful, it has the great advantage over all surgical interference that it involves no loss of tissue. In any operation it is necessary to cut wide of the disease, and thus the gap to be filled is larger than the neoplasm.

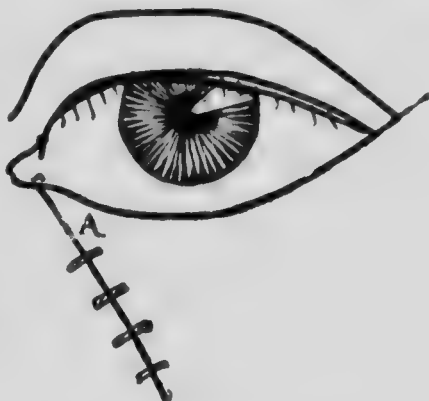


FIG. 78.—De Vincentiis' operation.
Final stage.

GROUP B.—The wound closed by grafts from a distance.

1. By flaps containing all parts of the skin.

(a) By a pedunculated flap. The Tagliacotian Operation.

In this method the new lid is taken from the skin on the inner side of the upper arm. The arm and head are held motionless in position during the first stages of healing by means of a special, somewhat complicated, apparatus. The method is rarely employed.

(b) By Wolfian grafts.

The use of Wolfian grafts gives us one of the readiest methods of dealing with the deformities of which we are here treating. The contraction, however, of these islands of separated skin is so great that their use is more limited than would at first appear. There is no special difficulty in their employment; if all subcutaneous tissue is removed from the flap, it unites with readiness to the bed, and since its nutrition is supplied from the deep surface and not from the margins, the size of the graft has little importance.

The contraction, however, is very disturbing; grafts lose as much as three-quarters of their original area. The method is, therefore, chiefly applicable to the upper lid, where the tarsal plate resists contraction.

2. The wound is closed by Thiersch grafts (epidermis grafts).

Hotz' Operation

Instruments.—Scalpel, dissecting forceps, scissors, pressure forceps, needles and needle-holder.

The steps will vary a little with the condition of the skin of the eyebrow. If the hairs are numerous, the skin cannot be used to make a new lid.

If, on the contrary, the brow have suffered in the cicatrization, the skin to cover the upper lid may be taken from it.

First Stage.—A large incision is made through the skin above the lid margin, beginning about 3 mm. above and outside the outer canthus, passing upwards in a curve to the brow and then descending in a curve to a corresponding point near the inner canthus. The large flap thus marked out is dissected up, and all cicatricial bands are cut until the lid can easily be replaced into its normal position. All bleeding must be stopped.

Second Stage.—The lid is stretched downwards by means of two or three sutures, which are passed through the lid margin and fixed down to the cheek by means of collodion.

Third Stage.—The flap of cicatricial skin is then fixed firmly to its bed by means of sutures which attach its upper border to the upper edge of the tarsus. This leaves a large elliptical raw area uncovered.

Fourth Stage.—The surgeon cuts with the razor a large Thiersch graft from the flexor surface of the forearm, of sufficient size to cover the whole raw surface, and places it in position, the edges overlapping the surrounding skin. No sutures are applied.

If, however, the presence of the eyebrow makes it impossible

to cut a new upper lid from the skin above the old margin both the lid and the facial flap must be made by Thiersch grafts. The first stages, then, will be rather different from those just described.

First Stage.—The surgeon makes an incision about the lid about 3 mm. above the cilia, and by free dissection mobilises the lid, so that it can be readily replaced. Excess of cicatricial tissue are then removed as far as possible.

Second Stage.—The lid margin is pulled strongly down by three or four sutures so as to make the gap as large as possible. The sutures are fixed to the cheek in the ordinary manner.

Third Stage.—The surgeon then cuts with the Thiersch graft and adjusts it to the surface of the lid, fastening it with numerous points of suture to the skin of the lid on the one side and to the upper edge of the facial flap on the other.

Fourth Stage.—The remaining gap is filled in by a second Thiersch graft, as in the preceding description.

If the surgeon has to do with cicatricial contraction of the lower lid, the choice of procedure is easier, because the tissues below the lid are always available for the formation of a skin flap.

Since the cartilage of the lower is thin and small, Hotz suggests that this flap be sewn to the orbital fascia below the cartilage proper.

EXTERNAL OUTLAYS

Enlargement of the Lid (24)

For enlargement of the upper lid.

First Stage.—A curved incision is made just above the lid margin. The flap is kept open slightly, but not carried so far as

to expose the eyeball. The skin above the incision is undercut, until the lid margin descends to a level lower than normal. In this stage care must be taken not to interfere with the levator palpebrae superioris.

Second Stage.—A mould is made of the cavity thus formed, of sterilised dental composition, which is softened in hot water, and trimmed until it fits snugly. The composition should be moulded and held by the fingers.

Third Stage.—A Thiersch graft is cut from the inner side of the arm, and used to cover the mould of the cavity; the epithelium must lie against the mould. The mould, covered with the graft, is replaced in the cavity.

Fourth Stage.—The margins of the skin incision are again brought together with sutures. The incision is not tightly closed, and thus the epithelium can grow round the margin of the incision.

The mould is left in place for some days. The immediate result of closing the incision is to cause an ectropion more pronounced than before, but when the wound is reopened and the mould taken out the lid at once falls to its normal level.

When the mould is removed, there are certain disabilities which become apparent, says Major Gillies: "There is no doubt as to the cure of the ectropion, but if a nice edge has not been produced, there is the appearance of an epithelialised ulcer, which, however, in the course of time, softens out remarkably with massage and the natural movement of the lid."

TARSORRHAPHY AND CANTHORRHAPHY

The operation by which the lids are united along their margins for whole or part of their extent is termed tarsorrhaphy. Occasionally the union of the extreme angles is called canthorrhaphy, and the term tarsorrhaphy reserved for those instances in which the new union does not reach to the canthus; and this division is useful because it enables us to distinguish readily between a union of the lids, at, for example, the region of the puncta lacrymalia from one affecting the inner angle. Accepting this division, we may agree with Terson in classifying these operations into six groups: inner and outer canthorrhaphy (uniting extreme lateral regions and practically forming new

canthi), internal and external tarsorrhaphy (uniting the parts rather nearer the middle of the lid), median tarsorrhaphy, and total tarsorrhaphy, when the whole palpebral fissure is closed.

These various degrees of union are, of course, needed for various conditions; it has been already mentioned that total tarsorrhaphy plays an important part in the operative treatment of many cases of ectropion, the lids being united temporarily, to prevent a recurrence of the deformity during cicatrization. The surgeon will open the fissure again some weeks after the union.

When the closure is temporary only, as in such a case, the surgeon will remove a strip as small as possible from the whole length of the post-ciliary zone of the lid margins, and unite the raw surfaces with several sutures.

This method of securing union may be employed in the formation of all varieties of tarsorrhaphy, excluding canthorrhaphy, for which it is not well adapted.

Median tarsorrhaphy is specially useful in the case of neuro-paralytic keratitis; here, by preserving the cornea from the intrusion of foreign bodies, the spread of the inflammation is prevented, and the ulcer, if formed, may be induced to heal.

Similarly, in the presence of lagophthalmos, from facial paralysis, a median tarsorrhaphy may save the patient's sight.

In slight cases of paralytic ectropion, when the collection of the tears and their overflow give rise to much discomfort, an internal tarsorrhaphy uniting the lids just external to the puncta lacrymalia for the space of 3 or 4 mm. will raise the lower lid and replace the everted punctum in its normal relation to the globe. All these unions may be effected by the procedure just mentioned, limiting its size in accordance with the needs of the case.

It is easy to separate the lids again whenever it may be thought that the object of the original union is attained.

Another method of gaining the same end has been invented by Bossalino. It can be used to unite the lids in whole or part as required.

Bossalino's (17) Tarsorrhaphy

Instruments.—Scalpel, lid plate, needle and needle-holder.

First Stage.—Having decided how far the new union of the lids is to extend, the surgeon splits the upper lid from that point to the canthus by making an incision in the grey line of the lid, thus dividing the anterior sheet, which contains the orbicularis and hair follicles, from the posterior, which consists of tarsal plate and conjunctiva. The incision is carried upwards until it is about 3 mm. deep.

Second Stage.—The lower lid is then split in the same way and to the same extent.

Third Stage.—Then taking a suture, armed at each end with a needle, the surgeon passes the needles through the posterior layer of the lower lid from the conjunctival surface, so that a loop is left on the conjunctiva; the points of emergence should be about 4 mm. apart.

Each needle is then introduced in succession into the wound in the upper lid at a point opposite the point of emergence from the lower, and carried upwards between skin and tarsal plate for about 1 cm. At this level, *i.e.* about 14 mm. above the lid margin, both are brought out on to the skin, and tied over a piece of drainage tube.

Priestley Smith (25) described in 1913 an operation for tarsorrhaphy which he has done for years previously:

First Stage.—He splits the lids rather deeply in the grey line, to a somewhat greater length than that of the adhesion desired.

Second Stage.—He passes a silk suture through the upper lid from without, so that it appears at the bottom of the groove, and thence into the bottom of the groove of the other lid and out through the skin. It again enters the skin 3 or 4 mm. to one side of the point of exit, and passes through both lids in the same way, to emerge close to the point of first entrance. Two or more such sutures are passed. They are then tied on the surface of the upper lid.

Pisarello (26) describes a precisely similar method, but uses doubly armed needles.

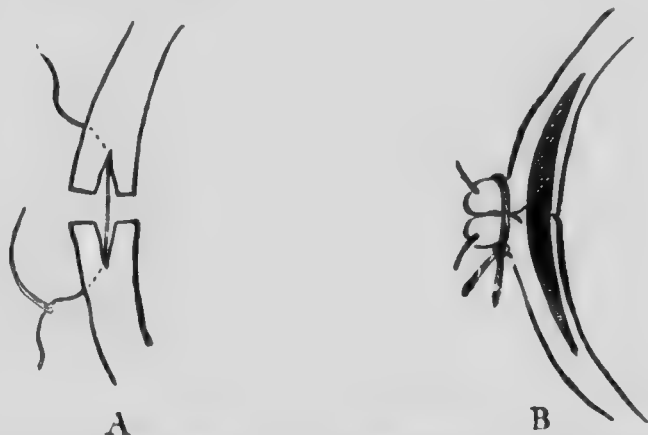


FIG. 79.—Tarsorrhaphy. A, after Priestley Smith; B, after Pisarello.

External tarsorrhaphy is rarely needed except in conjunction with canthorrhaphy.

Occasionally it is necessary to shorten the palpebral fissure, in order that the lids may close more easily over the globe and offer better protection. In Graves' disease, for example, the protruding eye is sometimes seriously damaged because of the non-closure of the lids.

External cantho-tarsorrhaphy, as it may be called, at once hides the deformity and remedies the defect.

The operation of Fuchs (18) is suitable for these cases.

Fuchs' Operation

Instruments.—Scalpel, dissecting forceps, scissors, needles and needle-holder.

Let us suppose that the surgeon thinks it desirable to close the outer part of the fissure for a distance of one-third of an inch.

First Stage.—The surgeon makes an incision of the required length in the grey line of the upper lid, and deepens it until

it reaches above the hair follicles. He then makes a second incision, about one-eighth of an inch long, vertically through the tissues of the anterior plane at the inner extremity of the first, and by a third incision unites the outer end of the first and the

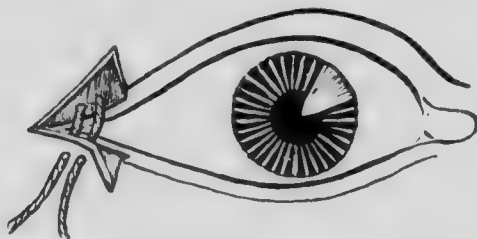


FIG. 80.—Fuchs' operation. *Middle of third stage: showing "mattress stitch."*

upper end of the second incision. In this way he removes the skin and hair follicles from a small triangular surface, leaving it raw.

Second Stage.—The surgeon now splits the lower lid in the grey line to the same distance as in the case of the upper, and by a vertical incision at the inner end loosens the area of the



FIG. 81.—Fuchs' operation. *Final stage.*

skin, which, however, is left attached by its lower margin to the lid tissues.

Third Stage.—The triangle of skin is raised to fill the gap left by the removal of the skin and hair follicles from the upper lid, and is held in position by several points of suture. To secure firm and complete union, the first suture should be passed in the way known as "mattress stitch," as follows:—A silk thread is armed at each end with a needle. These are passed from the conjunctival surface of the upper lid through the tarsal cartilage, and appear on the raw area; then through

the loosened skin flap of the lower lid from behind forwards; lastly, the ends are tied over a piece of drainage tube on the surface of the skin. The marginal wound is then closed by three or four separated stitches.

Hale (19) has recently modified this procedure. The original operation does not, in his opinion, give a satisfactory canthal angle.

First Stage.—The surgeon marks on both lids the point where the new canthus is to be. From this point he makes an incision downwards in the lower lid for about 5 or 6 mm., and from the lower end of this a second curved incision to the outer canthus. From the triangle contained between these incisions and the lid margin he removes all the skin and hair follicles.

Second Stage.—He now marks out on the conjunctival surface of the upper lid an area corresponding to that on the lower, but 1 mm. larger in each direction. Here he removes all the tissues except the skin, *i.e.* hair follicles, muscle, tarsal plate, and conjunctiva.

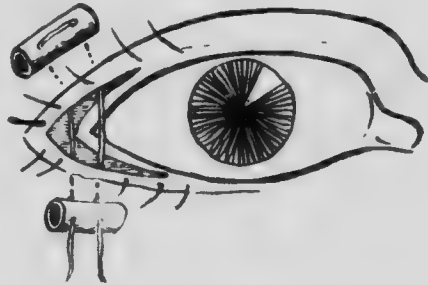


FIG. 82. Canthorrhaphy, after Harman.

As the result, he has now two flaps—that of the upper lid consisting of skin only, that of the lower containing all the subcutaneous parts. They are secured together as in Fuchs' operation, and the new canthus is formed.

Bishop Harman has drawn attention (27) to a deformity often seen in connection with artificial eyes, but occasionally seen at other times, in which the eye seems too small for the

socket, and a space is left between the eye and the outer canthus.

For this he has described a method of tarsorrhaphy, and a special clamp. The lower blade is diamond-shaped, with a notch to fit the frenum at the outer canthus. The outer blade, a frame, fits on the skin.

After the placing of the clamp, the lids are incised in the grey line for the length deemed necessary, and the skin layers are brought together. Harman's advice is to the effect that it is better to do too much rather than too little.

CANTHOPLASTY

On the other hand, it may be desirable to enlarge the palpebral fissure, *e.g.* in cases of blepharospasm. This procedure is called canthoplasty. The usual method is simple.

Instruments.—Stout scissors, needles and needle-holder. Pressure forceps may be at hand.

First Stage.—The surgeon places one blade of the scissors deeply in the commissural sac; he stretches the lids widely apart with his disengaged hand, and with a single cut of the scissors divides the commissure as far as he thinks proper.

Second Stage.—He then dissects up the conjunctiva from the region of the commissure for some distance (if this be not done, the fissure is not infrequently narrowed by recontraction) and stitches the conjunctiva to the skin of the lid by several points of suture.

Another method is that of Valude (20).

First Stage.—The surgeon picks up a vertical fold of skin outside the outer canthus, and divides it horizontally with scissors, making a wound about half an inch long.

Second Stage.—Then taking the scissors, he places one blade inside the cul-de-sac of the conjunctiva, and one in the wound and cuts first upwards and outwards, and then makes a second cut downwards and outwards, freeing the conjunctiva boldly.

Third Stage.—He then closes the skin wound by several points of suture, so as to make the wound + shaped. The

point of the conjunctival flap may be united to the new commissure, if necessary.

CHALAZIA

These little tumours very frequently need surgical interference. Often it is enough to incise them from the conjunctival surface and evacuate their contents; sometimes the walls are thick and must be dissected out.

The marginal chalazia are specially unsatisfactory to treat. For these it is best to make an intermarginal incision and express the contents through this; such an incision has been recommended by several surgeons, as a routine for all such tumours, even though situated far from the margin.

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CHAPTER V

OPERATIONS ON THE CONJUNCTIVA

OPERATIONS on the conjunctiva are among the more infrequent procedures of the English ophthalmic surgeon. Injuries of sufficient intensity to require surgical after-treatment are not very frequent, and diseases requiring operations are rarely met with here.

In other countries certain diseases, *e.g.* trachoma and pterygium, frequently call for operation. Good sanitary conditions in schools have almost banished trachoma from England. It may be feared that laxity in allowing alien immigration may cause an increase in this disease, but at present it is rare.

The conjunctiva bears injuries and operations well; it is well supplied with bloodvessels and lymphatics, and generally heals with great rapidity and little scarring. Occasionally, after a burn, or after destruction of a limited part of the conjunctiva from some other cause, the movements of the eye may be interfered with from the resulting cicatrices. These may then require operation.

OPERATIONS ON THE CONJUNCTIVA

SYMBLEPHARON

Symblepharon is an abnormal adhesion between the lid or lids and the globe. It follows, most commonly, burns of the eye from some chemical caustic—such as lime—but may occur as a part of certain conjunctival diseases, *e.g.* pemphigus conjunctivæ. In the latter conditions, which are, for the most

part, progressive, surgical interference can do little; in the former, it is sometimes possible to do much.

The lower lid is that most usually at fault; the adhesion is of importance not only because it may interfere with the power of vision, but also because it limits the movements of the globe, and the constant drag is most irksome to the patient.

There are two main forms of operation for its relief: one relies on the transplantation of flaps from the neighbouring conjunctiva, the other on the transplantation of epithelium from a distance.

The former is only applicable when there is sufficient conjunctiva uninjured to spare enough to cover the space left after dissecting the adhesion away; the latter is used when the adhesion is so extensive that the former is impossible.

Pridgin Teale's Operations for Symblepharon

Teale (21) has described two different procedures for the relief of this condition.

Instruments.—Scalpel, speculum, dissecting forceps, needles and needle-holder.

First Stage.—The surgeon makes an incision through the lid in the position of the margin of the cornea, leaving the apex of the adhesion still adherent to the eye. Then he dissects the lid freely away until the parts are as movable as in the normal state.

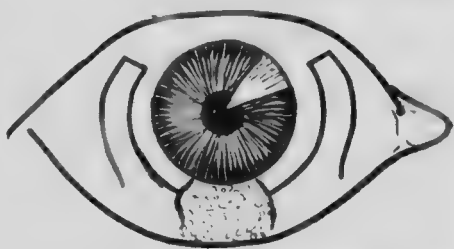


FIG. 83.—Teale's operation. The lid is dissected free and the covering flaps marked out.

Second Stage.—On the conjunctiva on each side of the cornea he marks out a flap, about 16 mm. long and about 6 mm. in breadth; the limiting incision on the corneal side of each is carried down to join the wound made by the first dissection.

Third Stage.—A suture is passed at each apical angle of the

flaps, and each is then raised from the globe and turned on its pedicle to assist in filling the gap. The dissection required to raise the flaps must be made very carefully to avoid any

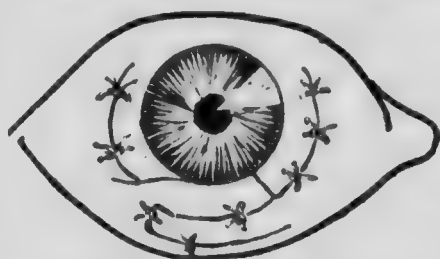


FIG. 84.—Teale's operation. *Final stage:* the defect covered by the flaps.

false cut which might spoil the chances of the whole. Unless the sutures are placed in position in the corners before the dissection is made, the flap will be likely to roll up, and this will prevent accurate adjustment.

Fourth Stage.—The secondary wounds are easily closed from their edges.

Teale's (22) Second Method

The *First Stage* of the method is similar to that of the first plan.

Second Stage.—The surgeon marks out a bridge flap of conjunctiva, arching over the cornea. The two limiting incisions should be about 6 mm. apart, and their ends must be turned somewhat outwards. The lower incision must join the dissection wound at each end.

Third Stage.—Two sutures must be inserted into each border of the bridge-flap at about the ends of the middle third, and the whole raised by dissection. The silk threads will prove a great assistance during this part of the operation, which is always very slow and difficult.

When the dissection is complete the bridge is brought down across the anterior surface of the cornea and secured into the bare area by the sutures.

Fourth Stage.—The secondary wound is covered by drawing together the conjunctiva on each side of it.

May's Operation

May (20), about 1897, began to use the method of operation which in the last edition we attributed to Hansen (Grut.

Hansen Grut was making use of this operation about 1902, whether evolved independently or adopted. Abadie (23) described it as seen in the clinic of Hansen Grut.

The design of the operation is simple and efficient.

Instruments.—Scalpel, razor, artificial eye or glass mask, needles and needle-holder.

First Stage.—The surgeon makes a new cul-de-sac with the scalpel.

Second Stage.—After the bleeding is stopped he cuts from the forearm a large Thiersch graft, which he applies to the border of the artificial eye, so that the epithelium is in contact with the anterior and posterior surfaces.

Third Stage.—Then the eye thus clad is placed into the new fornix and the lids secured over it by a few points of suture. It is not necessary to scarify the edges before applying the sutures, since the lids need be closed for only a short time.

TOTAL SYMBLEPHARON

For this serious condition Prawossud (27) suggested the following operation: After making an incision through the external canthus, he turned down the lower lid as a rectangular flap on to the cheek, and covered the exposed raw surface with a flap of mucous membrane. Sutures were passed through the mucous membrane flap at the level of the intended cul-de-sac, and tied on the cheek. Finally, the lid was replaced in position and sutured.

Morax (1), for injuries in the war, used a very similar method, but covered the raw surface with a Thiersch graft, instead of mucous membrane, and kept the lids everted for some weeks before he closed them over a prothesis.

Owing to the length of time taken in the whole convalescence, Morax revised the procedure and used a method very like that of May. He makes a single incision in the line of the palpebral fissure, but longer by a centimetre at each end. From this he dissects upwards and downwards as far almost as the orbital margin. The flaps consist of skin and

orbicularis. He makes a mould of the cavity formed by the dissection in paraffin, and covers this with the Thiersch graft. The coated mould is then inserted into the cavity and the lids closed over it by sutures.*

Weeks (26), in similar conditions, made use of a large Wolfian graft, which he applied round a plate of hard rubber and stitched down to the periosteum at the orbital margin. There seems no doubt that in cases which require large measures a division of the external canthus is necessary to give a sufficient space for the operation.

CONJUNCTIVAL FLAPS

The value of conjunctival flaps in protecting wounds of the eye, surgical or other, is generally admitted. It is true that a few surgeons, among them Colonel Smith, disapprove of their use (2), on the ground chiefly of the time taken in the making of the flap. But the advantages seem to us to outweigh the disadvantages completely.

Wounds of the conjunctiva unite with great rapidity; a conjunctival flap will heal in a few hours and will serve to protect the opening in the sclero-cornea from infection. This opening would otherwise remain patent for a considerable time, during which septic material might gain access to the interior of the eye. When there is no conjunctival flap, patients usually complain for two or three days of sudden

* In his last pronouncement on the subject, in the Bowman Lecture for 1919, to the Ophthalmological Society of the United Kingdom, Morax seems to have gone back to the first method. He describes the operation in the following steps: first, an H-shaped incision longer than the palpebral fissure; then dissection of the "lids" as far as the margin of the orbit, and fixation of their free edges to skin incisions near the eyebrow and on the cheek, so as to hold the bed for the graft, extended. The third stage is the application of the Thiersch graft, which is covered with gauze impregnated with wax; this allows the passage of serum and the change of dressing without displacing the graft. After a fortnight, the lids are freed from the incisions in the cheek and eyebrow, and are closed over a prothesis.

Sometimes Morax combines this operation with the use of a pedunculated flap from the temple, to form the posterior layer of the new socket.

gushes of fluid from the eye, each accompanied by discomfort amounting sometimes to pain. There is little doubt that this is the escape of aqueous, or at least of fluid from the aqueous chamber. When there is a conjunctival flap this disagreeable sequel is seldom met. Further, each opening of the anterior chamber may be complicated by prolapse of the iris; a small prolapse is less likely to become infected and troublesome if covered by conjunctiva than if it be exposed on the surface.

Recognising the value of these flaps in surgical wounds, many surgeons have proposed to utilise them in all cases of loss of corneal tissue, and thus to protect and hasten the cicatricial process.

Thus, in intractable corneal ulcer, or where a perforating ulcer has given rise to a large prolapse, a conjunctival flap may with advantage be fixed over the area.

There are several ways of making these flaps, but generally they may be considered as taking one of three forms.

They may be :

- (1) Pedunculated.
- (2) Bridge flaps.
- (3) "Hood" flaps.

The first plan consists in cutting a flap with a pedicle, turning it over the affected area, and securing it either directly to the cornea, or to the conjunctiva at the nearest suitable point. This plan has few advantages, and is only of limited applicability. In the second method, a bridge of conjunctiva, surrounding one half of the cornea and of the desired width, is dissected up, placed across the cornea so as to cover the affected area, and secured by means of stitches near its extremities.

The last method, the "hood" flap, or as it is sometimes called, "Stanculeanu" flap, is the most generally useful. The conjunctiva is divided round the corneal margin for the necessary distance and loosened by dissection; it is then drawn over the affected area and fixed by two stitches.

If necessary, the whole cornea may be covered, by dissecting up the whole conjunctiva and drawing it over, either by a purse-string suture or by closing horizontally.

Conjunctival flaps, in connection with surgical wounds, are generally cut from within outwards by transtixion. They then are either flaps with a broad basal pedicle, or, if unseparated at their distal end, become bridge flaps.

Desmarres (3) often made use of the bridge flap in the extraction of cataract, and the plan has recently been revived. Sometimes the flaps are made from without inwards; and this is specially the case in such operations as trephining, where the main instrument is not adapted for cutting the conjunctival flap. The flap is then cut as a preliminary measure by scissors.

Occasionally, as in Van Lint's operation for cataract (4), a hood flap is dissected up before the incision is made in the sclero-cornea.

A few surgeons "balloon" the conjunctiva by means of a subconjunctival injection, previous to cutting the flap. This seems to make the procedure more difficult, as the relations of the parts are disturbed.

PTERYGIUM

Pterygium is the name given to a fold of the conjunctiva, which grows in a roughly triangular shape over the cornea from the inner side towards the pupil. In the more advanced stages it interferes with vision by covering the central part of the cornea, and therefore it must be attacked while vision is still good. In the later stage a second fold sometimes appears on the outer side.

Under certain conditions it is very prone to relapse.

This curious disease has attracted, and still attracts, an amount of attention, which may seem to English surgeons out of all proportion to its proper importance. It is seldom possible to look through the pages of a volume of any

ophthalmological journal without finding "a new operation for pterygium." Yet we in England are seldom called upon to treat a pterygium, and those which we meet are easily dealt with. The explanation is that pterygium is a disease which varies enormously in its incidence; its nature is obscure; it has been stated positively, and as positively denied, that it is in close causal relation to pinguecula.

McReynolds, who has had great experience of pterygia in Texas, states (5) that he has frequently met it in young boys, in whom pinguecula is not likely to be developed, and implicitly denies the connection.

Sachsaler believes that the inversion of downy hairs near the inner canthus has an important bearing on the disease. He states that by pulling out the hairs he can bring the disease to a standstill. This explanation cannot hold for the pterygia which begin on the outer side.

One thing seems certain, that it particularly affects the dwellers in hot, dry, windy countries, where dust, and especially alkaline dust, is excessive. In such countries pterygium is frequent and prone to relapse after removal. In England, pterygium makes little progress, but rather regresses, and seldom, if ever, recurs after removal.

The fold of conjunctiva, as it grows over the cornea, is not attached to this in its whole breadth, but only by a comparatively narrow central "mesentery." Under this, the corneal epithelium and Bowman's membrane are wanting, and replaced by new vascular tissue.

True pterygia always arise in the horizontal meridian of the eye, in that line which is most open to the entrance of dust. After extensive ulceration or burns of the cornea, somewhat similar folds may be seen in other directions; these are called pseudo-ptygia.

Clinically, we may divide pterygia into two classes. Those that we see in England are mostly thin, semi-transparent, and very slightly vascular—they form the group called "pterygium tenue." When the fold is thick, vascular, and progressive, it

is called "pterygium crassum." If we remove a patient suffering from the latter form to suitable surroundings, the pterygium may regress and become "tenuum."

In England, as we have said, any form of operation succeeds in removal. In countries where the disease is endemic, the surgeons say that no form of simple excision is of use, but that transplantation is necessary.

There are several methods of treatment which are efficient; the original operation of transplantation was devised and advocated by Desmarres.

Desmarres' (24) Operation of Transplanting a Pterygium

Instruments.—Speculum, fixation forceps, scissors, needle and needle-holder.

First Stage.—The pterygium is picked up with the forceps and dissected off the cornea and sclerotic for its whole length; since the mass is attached to the globe by a narrow band only, this dissection makes a comparatively narrow gap in the conjunctiva.

Second Stage.—From the lower border of the incision the surgeon makes a second curved incision downwards about 10 mm. long, running concentrically with the cornea, about 4 mm. from the limbus.

Third Stage.—He then dissects up the conjunctiva on the margins of this wound, and into this gap transplants the pterygium, fixing the apex into the lowest part. The conjunctival flaps are now brought over the mass and secured by two or three points of suture.

If treated in this way, the return of the pterygium is satisfactorily prevented. There is, however, a small disadvantage in that the mass makes an irregular elevation on the side of the cornea; to lessen this deformity, Knapp (25) has proposed a slight modification of the procedure. He splits the pterygium into two parts and sutures each half separately under the conjunctiva.

Knapp's Operation

Instruments.—As for Desmarres' operation.

First Stage.—The pterygium is picked up in forceps and

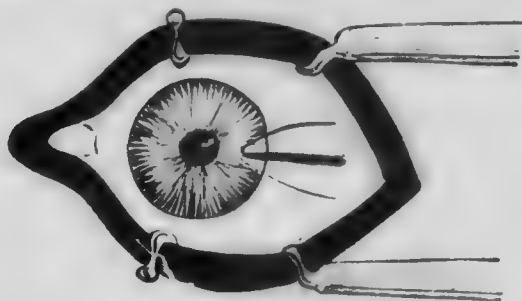


FIG. 85.—Knapp's operation. *First stage*: division of the pterygium.

dissected off the globe; then, still held in the forceps, it is divided from apex to base by a horizontal incision with the scissors.

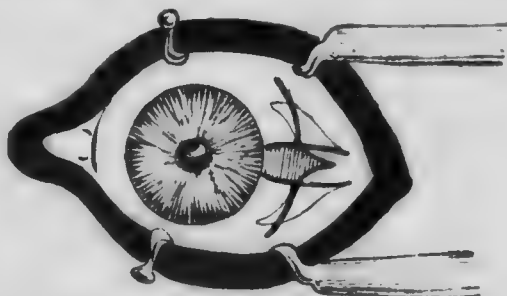


FIG. 86.—Knapp's operation. *Second stage*: each half is turned under the conjunctiva.

Second Stage.—From the horizontal gap left by the dissection of the pterygium, two incisions are made, one upwards

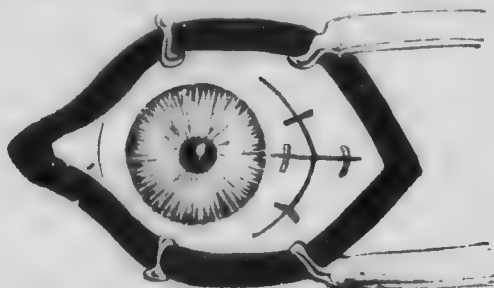


FIG. 87.—Knapp's operation. *Final stage*.

and the other downwards, extending about 10 mm., and the edges of the conjunctiva dissected up.

Third Stage.—Each half of the pterygium is fixed separately into one of these wounds and the conjunctiva is sutured over.

McReynolds' Operation

McReynolds, about 1902, devised a modification of transplantation which has given excellent results. He has had a

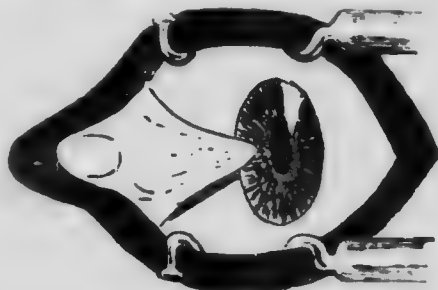


FIG. 88. McReynolds' operation. *Second stage.*
The dark line represents the conjunctival incision

large experience of this condition, and his opinion is therefore very valuable.

First Stage.—He grasps the neck of the pterygium with strong but narrow fixation forceps, passes a Graefe's knife

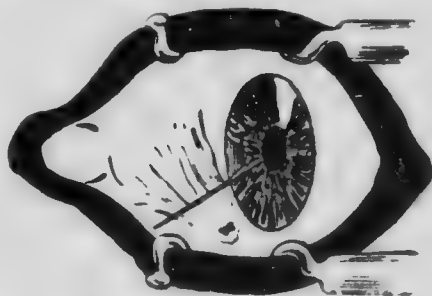


FIG. 89. —McReynolds' operation. *Last stage.*

through the mass as close to the globe as possible, and shaves the head smoothly from the cornea. Every particle of the growth must be removed completely and carefully.

Second Stage.—Still holding the pterygium in the forceps,

he divides with slender scissors the conjunctiva and subconjunctival tissue, along the lower margin of the pterygium for about $\frac{1}{4}$ or $\frac{1}{2}$ inch; and separates the body of the growth from the sclera by any small non-cutting instrument.

Third Stage.—He picks up the conjunctiva below the oblique incision with forceps, and undermines it downwards as far as the fornix.

Fourth Stage.—He then passes both needles of a doubly-armed suture through the head from within outwards, and carries the needles down under the conjunctiva to the fornix, where he brings them out about $\frac{1}{2}$ inch apart.

Fifth Stage.—When these ends are tied the pterygium is drawn into the pocket of conjunctiva and secured there.

McReynolds lays stress on the absence of any incision along the upper border of the pterygium. There is no bare sclera to cover.

Galezowski (6) suggested that the head of the pterygium should be doubled under itself. In this way he thought that relapses would be prevented, since the mucous membrane would not adhere to the sclera. Bettman (7) later redescribed this procedure under the name of subvolution. The pterygium is dissected off the cornea, and a doubly-armed suture passed through the head from the superficial surface. The needles are passed under the growth, and emerge through the body, so that when the suture is tied the head is folded under. A bare area of sclera is left, which is covered by sliding conjunctival flaps.

Recently Alexander (28) has suggested that it is unnecessary to cover the bare area.

PSEUDO-PTERYGIUM

This name is applied to cicatricial folds which are drawn over the cornea as the result of the healing of extensive burns or other injuries, associated with great destruction of conjunctiva. They do not threaten vision by spreading, but

limit movement, and sometimes give rise to troublesome diplopia.

It is said by some authorities that the folds which recur after removal of pterygia are always of the nature of pseudo-ptyerygia.

Gifford (8) has found the best results in these cases follow a free dissection of the fold back from the cornea, and the placing of a Thiersch graft of skin on the raw surface left. He points out that there is one disadvantage connected with this: the epithelium graft retains the characters of skin, and the movements of the lid are insufficient to carry away the epithelial debris which accumulates on the surface. It is necessary to wipe the graft carefully every day, or even twice a day, to remove the accumulation.

PERITOMY AND PERIDECTOMY

This little operation was originally introduced into ophthalmic practice by Dr. Furnari, of Paris, in 1862 (9), and was called by him "*tonsure conjunctivale*," or syndectomy. It is very useful in the treatment of some vascular opacities of the cornea. At first the operation meant the excision of a strip of conjunctiva and subconjunctival tissue surrounding the cornea, exposing a ring of sclera about $\frac{1}{2}$ inch wide, the object being to set up a ring of cicatricial tissue which would limit the vascular congestion.

It was soon found that the removal of conjunctiva was unnecessary, and even disadvantageous, and therefore the operation was lessened to the incision of the conjunctiva all round the cornea, and a dissection backwards to expose a ring of sclera. Over the area laid bare, all vessels entering or leaving the sclerotic are divided.

The conjunctiva soon heals down again—too soon in some cases to allow the formation of the required cicatricial ring, and some surgeons, e.g. Teale (10), are accustomed in severe cases to make three or four radial cuts through the conjunctiva, to retard the union.

Most surgeons would limit its applicability to certain vascular opacities of the cornea, especially pannus, but Teale held that it had great curative value in episcleritis and iritis.

The operation aims at cutting off the vessels from the cornea, and the success is greatest when the vessels are superficial.

Instruments.—Speculum, fixation forceps and strabismus scissors; sometimes a small squint hook is useful.

In peritomy proper the surgeon picks up a fold of conjunctiva at some point near the cornea, and cuts through it with the scissors, as close to the sclero-conjunctal junction as possible. He extends the incision all round the circumference of the cornea, if necessary. If there are only a few separate vessels, confined to a limited zone, he will adapt the length of his incision to the needs of the case. He then picks up the bulbar conjunctiva in the forceps, and dissects it back for about a quarter of an inch.

The vessels are divided, and the cicatrization of the healing tissues causes a contraction sufficient to strangle any new vessels which may be formed afterwards.

In peridectomy, the effect is increased by cutting away the part of the conjunctiva which has been dissected back; the scar tissue is more abundant, and the bar against new vessels more secure.

Deeper vessels may be obliterated by the galvano-cautery.

Critchett had a great opinion of the value of peritomy in suitable cases of pannus. He taught that it was necessary to remove all the subconjunctival tissue as completely as possible, and often excised a strip of conjunctiva $\frac{1}{4}$ inch wide.

Since the operation depends for its result on the formation of scar tissue, which strangles the corneal vessels, it is not likely to succeed in those patients who do not form firm scar tissue. Critchett was careful never to operate in such conditions. Further, he explained to the patient that success would not be immediate, but would develop gradually, until,

perhaps six or eight months afterwards, the best result would be found.

His experience led him to the belief that at a certain stage of trachoma a cure of the pannus meant amelioration or cure of the lids.

It may be disputed whether it is justifiable to perform a peridectomy in a case of chronic glaucoma, or where there is any suspicion of this disease. The obliteration of the circumcorneal venules has been used as a method of raising the intra-ocular pressure, when the tension has been sub-normal. Certainly, the presence of a ring of scar tissue round the corneal limbus would make certain procedures very difficult, but, with this exception, there seems no contra-indication.

TRACHOMA

Treatment of trachoma by the application of caustics and astringents only is a very long and unsatisfactory process. The adoption of some form of surgical treatment to shorten the length of the disease is therefore imperative.

Surgical treatment may be carried out on many lines, but, in the main, they tend either to remove the new granulation tissue by emptying the granules, or to remove the granules whole in the tissues containing them.

In the early stages of the disease, the first plan is probably best, and should always be tried; the latter seems specially useful in later stages.

The granulation- may be emptied by "grattage," curetting, or by expression. The first is much praised by French surgeons, and can be performed with almost any rough instrument. Recently this method has been taken up by some American surgeons. Coover (11) suggests using sand-paper for the purpose.

In mild cases with few granules it may be possible to open each individually and scrape out the contents with a small, sharp spoon. But generally English surgeons adopt some form of expression by means of pressure forceps. Knapp (12)

has described a form of forceps which have been very largely utilised. They consist of grooved rollers, held in stirrup-shaped ends, which act on the principle of the domestic mangle. Their use is often combined with preliminary scarification.

Galezowski (13), about 1874, advised the excision of the retrotarsal fold, which contains the mass of trachoma granules that commonly escape treatment by the usual applications of blue-stone.

Heisrath (14), in 1882, added to this the removal of the upper part of the tarsal plate. This procedure fell into disuse, but was revived by Kuhnt in 1897 (15).

It has been much advocated in Italy by Addario (16), and in the United States by various surgeons, especially Wootton (17) and Claiborne (18).

Addario (16) seems to have been the first to suggest the excision of the retrotarsal fold with the superior part of the tarsus and the bringing of the conjunctiva down to meet the remains of the tarsus near the lid margin. It was almost simultaneously suggested by other surgeons, and a little later Claiborne (18) regularised the operation.

They claimed that the disease was practically always brought to a standstill, and that great improvement of the pannus followed. Dickson (19) advocates the excision of the pannus. He dissects the vascular tissue from the subjacent cornea, and leaves this almost clear.

Coover (11) is a strong supporter of grattage. He uses for the purpose strips of sand-paper. This must be carefully selected. No. 0 or 00 is best; and there must be pure sand and no glass on the paper. Coover cuts it into strips $\frac{1}{4}$ inches by $\frac{1}{4}$ inch, and sterilises them by dipping them into alcohol and burning this off. He advises that general anaesthesia should be induced, as the procedure is very painful, though the after-effects are surprisingly slight. He everts the lids and retrotarsal fold, and puts in a horn plate to protect the cornea. He wraps a strip of the sand-paper

round his index-finger, and rubs the conjunctiva thoroughly and briskly over the whole surface affected. When the rubbing is completed, he washes the lids with a copious douche of normal saline.

In England, expression with Knapp's forceps is probably the most usual form of surgical treatment. The method of use is to evert the lids, to place one blade in the fornix as high as possible, and the other on the everted surface of the tarsus. The surgeon then draws the forceps down, keeping constant pressure on them, so as to squeeze out the contents of the granules. The surgeon must wear protective goggles during this manoeuvre, since the contents are expressed with considerable force, and may be thrown into his own eye.

When the forceps pass the retrotarsal fold, they flatten it out, so that it becomes, from a thick, rounded mass, a limp membrane.

All parts of the conjunctiva must be treated in the same way, until all the granules have been expressed. Some surgeons rub into the lid after the expression a strong solution of some antiseptic, *e.g.* 1 per cent. corrosive sublimate. If this is done, the cornea must be protected carefully, and the excess washed away with copious douching before the lid is replaced. Others confine themselves to douching with normal saline. We have never seen harm follow the use of antiseptic, nor is there often much reaction.

It has been urged against this treatment that it causes destruction and much consequent scarring of the conjunctiva. The general opinion, however, seems to be favourable.

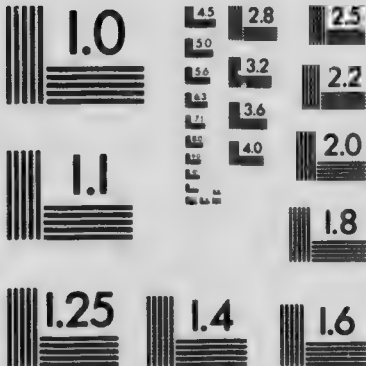
Claiborne (18) states that he considers the cicatricial tarsal plate as the chief enemy in trachoma. He thinks that by removing this the surgeon can get rid of the disease. He uses for the operation a special clamp, modified from Desmarres', having a fork with five small spikes on the arms, to lie inside the lid, and a metal plate, slightly shorter than the fork, to lie on the skin surface.

He places the clamp in position and everts the lid. Then



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he makes a curved incision, following the outline of the fork, through the tarsal plate. As this is cut it tends to spring away from the underlying tissues, owing to the cicatricial curvature.

He dissects the tarsus away from its loose connections, and undermines the conjunctiva behind the tarsus as far as the fornix.

He then passes three doubly-armed sutures: he pulls the tarsus upwards, and passes the needles through the con-

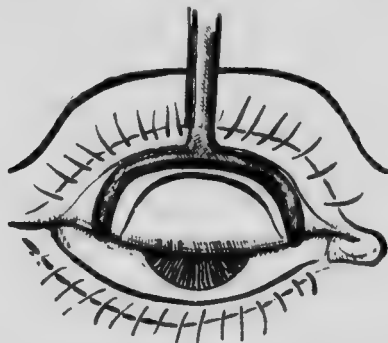


FIG. 90.-Claiborne's method of excision of tarsal plate.
The dark line in the fork of the clamp shows the line of incision.

conjunctiva just below the lower border of the tarsus. The needles are brought up between the tarsus and the remaining layer of the lid, and left on the forehead.

The surgeon then cuts the tarsus away, and takes off the clamp. The sutures are then passed through the lid, to emerge about 5 mm. from the lid margin.

Dickson's Operation (19)

Dickson attacks the pannus itself. He makes an incision about 3 to 5 mm. from the cornea through the conjunctiva as if about to do a peritomy. He rolls the flap over towards the cornea, and, holding it in broad forceps, dissects it down with iris scissors, trying to get under the bloodvessels, and as close to clear corneal tissue as possible. If there has been no ulceration the task is easy, he says, but if there have been ulcers each ties the pannus tissue down to the corneal stroma,

and makes the dissection more difficult. The thicker and more vascular the pannus, the easier it strips. The cornea left is almost normally clear.

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CHAPTER VI

ENUCLEATION AND ITS SUBSTITUTES

THE operations which will be described in the following chapter are such as are only undertaken on eyes which have no claim to be considered as organs of vision, but require surgical treatment, either for the relief of pain, or for the removal, in whole or part, of a damaged organ, which, allowed to remain untreated, might prove a source of danger to its possessor.

As regards the order in which they are here dealt with, it has been thought most convenient to take first the operations for complete removal of the globe, and then the substitutes for simple enucleation in "cosmetic" order, passing from optico-ciliary neurotomy and other procedures in which no tissue is removed, through partial amputations and eviscerations, to the modified enucleation operations, in which a glass ball or other body is put into the empty capsule of Tenon.

This arrangement is, perhaps, hardly logical, but the operation of enucleation is of so much importance, and demands so much consideration, that its convenience has outweighed other factors.

Removal of the eye, in some sense one of the largest, though by no means the most delicate, operations in ophthalmic surgery, is also one of those most frequently required, and one which may have to be performed by every practitioner.

The more special operations are, for the most part, entrusted to men who, by special training, are more accustomed to their performance; removal may be an urgent necessity which can allow no delay.

It is called for, not only on account of disease (such as malignant growth), which might by extension endanger the sufferer's life, but much more commonly to prevent, by removal of one inflamed and damaged organ, the possibility of the loss of the uninjured fellow by sympathetic inflammation.

The fear of sympathetic ophthalmia has, no doubt, frequently caused surgeons to excise eyes which might have recovered some, perhaps even a large, fraction of normal vision; but it cannot be doubted that it is better to sacrifice a badly damaged eye than run any great risk of total blindness, and the treatment of sympathetic ophthalmia is so uncertain, and the prognosis so bad, that we cannot wonder that many patients are pressed after injury to submit to immediate removal without any attempt to save a seriously hurt eye.

But if we are, by operation, to avert the danger of loss of both eyes, we must surely do our best endeavour to minimise the resulting deformity, and hence, despite its simplicity, simple removal is slowly but steadily losing ground as a routine operation in all cases, while one or other substitute is adopted; it is still, however, that most commonly employed.

The question of the best and safest cosmetic operation to cover removal of an eye has been largely discussed during the war, though it has been complicated by the character of the injuries. As is well known, wounds of the eye have formed an extraordinarily large proportion of the total injuries, and the cases of excision have therefore been very numerous.

In general, where the eye alone was damaged, the treatment has been immediate excision from fear of sympathetic inflammation; some surgeons—De Lapersonne, Dianoux, and Terrien, in France—have protested against the practice. They point out that a delay of a few days can do no harm since there is no record of sympathetic inflammation coming on in less than ten days, and that there is no other reason for immediate interference; hæmorrhage from a damaged eye is never dangerous, and sepsis is not prevented by

excision. By delay it may be found possible to save some sight, and this is specially important when both eyes have been damaged.

The relative value of enucleation and its various substitutes has not been decided, in spite of discussion; the general sense is against excision without some attempt to give a large and moving stump. But beyond this point opinions vary enormously. Weekers (33) is a strong advocate of evisceration. He has done no excision for a long time, and is convinced that evisceration gives as great safety against sympathetic inflammation as excision; Terrien (34) holds that in many cases evisceration is the best procedure to adopt. On the other hand, Valois (35) considers no operation justifiable which retains any part of the damaged eye, and quotes a case, reported by Kalt to Morax (36), in which evisceration was performed on the fourth day after the wound, and yet was followed by sympathetic inflammation of the fellow eye. The history is not absolutely convincing; the dates are as follow: the man was wounded on April 24, 1917; evisceration, April 28; sympathetic inflammation of the fellow eye (iritis and œdema of the papilla) appeared on June 1; the stump was excised on June 14; complete recovery with normal vision by August 1.

This is a very unusual course for sympathetic inflammation to run; the diagnosis seems to have been made on clinical grounds only. There is nothing in the very brief record given by Morax to show that the pathological anatomy of the excised stump supported the diagnosis, and though a pathologist can recognise the signs of an inflammation of a "sympathetic" type in the uveal tract of an eye, there should be little in the stump after an evisceration to assist in such an investigation. Clinical grounds only do not allow us certainly to distinguish sympathetic cyclitis from other simpler forms, and œdema of the papilla is a rarity in this disease. We may therefore keep an open mind, while waiting further evidence.

It must be remembered, also, that a number of cases have been recorded in which sympathetic inflammation—generally, though not always, of a mild type—has followed excision; among these there had never been an interval of less than fourteen days between the receipt of the wound and the excision.

Many surgeons have had large experience of evisceration, and have had no cases of sympathetic inflammation; but the negative evidence of this kind cannot weigh against that of others who have unfortunately seen such cases. Our own experience of evisceration (including in that term Mules' operation) was considerable, and we never saw any case of sympathetic trouble; yet we have abandoned Mules' operation because the total experience of the profession seemed to show that the risks were excessive. It seems to us at present unproved that simple evisceration carries any appreciable risk; if the stump left after evisceration is much superior to that after simple excision, we think that evisceration may be adopted. It would appear, however, that this first point is not yet settled; though Terrien speaks strongly in favour of the retention of the sclerotic in the stump (34); Dor (37) reports that a majority of the stumps left after evisceration are defective and give trouble to the patients. As far as our experience goes, such trouble is exceptional; Dor would seem to have had an unfortunate series of results.

Those surgeons who allow the retention of any part of the sclerotic usually attempt to remove the uveal tract completely. The amount of sclerotic preserved varies with the surgeon; Lister (38) has made a practice of retaining a frill of sclerotic round the optic nerve. By such an operation the spaces in the nerve sheath are kept unopened, and are therefore not readily infected from septic material. Some, as for example Weekers, retain as much of the sclerotic as possible, but remove the cornea; others retain the cornea. The point as to the cornea is not of great importance; the main thing in all eviscerations is the complete removal of all the uveal tract.

On the other hand, some surgeons, regarding the head of the optic nerve and the ciliary nerves as dangerous, remove the posterior part of the sclera; this is Nicati's "sub-enucleation."

A few (39, 40) try to satisfy both requirements, and excise both the anterior and the posterior parts of the sclero-cornea, leaving a ring of tissue, to which the muscles are inserted.

Francesco Ré, on the other hand (41), aims at preserving as much of the eye as possible; he makes a meridional incision about 15 mm. long, between the superior and external rectus muscle, and through this removes with a spoon the vitreous and retina, and, if necessary, the lens and iris; he places a ball of catgut in the empty vitreous chamber, and sews up the wound. So far, he says, the operation has succeeded better when the iris was left than when it was removed. The ball was seldom retained if the iris and lens were absent.

His results were chiefly experimental, and it does not appear to us likely that many surgeons will adopt his plan, which seems more dangerous than any other.

If the sclerotic is to be removed, it is very desirable to give the muscles some firm place of attachment in order that the stump may be mobile. With this object Valois (35) attaches the tendons to a diamond-shaped piece of sclerotic removed from the excised globe. It seems doubtful whether this will give a good support permanently.

With the same object, Carlotti and Bailleul (42) suggest the use of a fragment of costal cartilage, which they fix first to a skin-flap from the upper lid; this serves to nourish the cartilage during the first days after the operation. The flap with the cartilage is passed into the conjunctival sac and the muscles secured to it. The authors lay great stress on the importance of the skin-flap. Others have found it easy to implant the cartilage at once into the space left after removal of the eye. We have had little experience of this

procedure; in one case which we have seen the piece of cartilage implanted was of irregular shape, and the resulting socket and stump were not conveniently adapted to an artificial eye. This was the fault of the operator, and not of the method.

Gillies (44) describes a method of implanting a "cup and ball" prosthesis of cartilage in cases where the orbital contents were much shrunk; the cup had a conical end which extended back almost to the apex of the orbit.

It has been suggested that the vitality of the cartilage is so great that it could be implanted even in those orbits where there was active sepsis but there is little evidence on this point.

The one obvious advantage to this procedure is that it entails a second operation—on an uninjured part—to obtain the cartilage for the graft; the ninth costal cartilage is that generally selected.

The same objection applies, with perhaps rather less force, to Rollet's cutaneous graft. Sourdille, who has had large experience of this operation (45), reduces the thickness of subcutaneous fat to 2 mm. An advantage of the cutaneous graft is that it does not withdraw conjunctiva from the culs-de-sac.

These various additions to enucleation will be studied further later.

The old operation for removal of the eye, which remained in use till 1841, was one of the rudest imaginable. A stout silk thread was passed through the eyeball, and this drawn forcibly forward; then the surgeon took a double-edged knife, and, thrusting it through the conjunctiva into the orbit behind the eye, swept it round until all the tissues were divided and the eye free. It is hardly necessary to add that the stump very seldom allowed the use of an artificial eye.

In 1841 Ferrall (46) described the anatomical relations of Tenon's capsule to the muscles and the orbital fat, and pointed out how it was possible to remove the eye easily by working

inside this capsule. He originated enucleation, which at once supplanted the barbarous operation just mentioned.*

ENUCLEATION

For the performance of this operation a general anæsthetic is necessary.

Instruments.—Speculum, fixation forceps, squint hook, strabismus scissors, large curved scissors; a pair of pressure forceps may be added, but will probably not be required.

The procedure may be considered in three stages:—

First Stage.—*Opening the Capsule of Tenon.*—Seizing the conjunctiva in the forceps, the surgeon divides it all round the circumference of the cornea, leaving as little of the membrane as possible adherent to the globe. He dissects the conjunctiva and subjacent capsule back slightly so as to open the space of Tenon.

Second Stage.—*Division of the Recti.*—The four recti muscles are picked up with the squint hook in succession, and divided with the scissors. The globe is now held only by the oblique muscles and the optic nerve, and it can be without difficulty dislocated forwards beyond the palpebral fissure. It is well to do this now, since if it is not done the surgeon may find a little difficulty in getting the globe out after division of the optic nerve.

Third Stage.—*Division of the Optic Nerve and Removal of the Eye.*—The large curved scissors are passed down on the inner side of the eye, and the optic nerve is felt for. It is easily recognisable as a thick rounded cord.

The blades are then opened and placed one on each side of the nerve, so that they divide it by a single cut. If it is desired to remove as much as possible of the nerve with the

* But though Ferrall is very rightly given the credit for originating this operation, Cleobury (47) in 1826 described his method of removing an eye, from which it would seem that he knew the advantages of keeping inside Tenon's capsule. He divided the conjunctiva, "and next all the muscles inserted into the globe. This being done the point of the knife should be carried cautiously backward, and the optic nerve divided. Very little hemorrhage succeeds this operation." This remark has a very important bearing on the point.

globe, the ends of the scissors must be pushed back along the optic nerve, towards the optic foramen. This is the reason why the scissors must be inserted at the inner side. If they are passed from the outer side, the nerve cannot be found as readily nor divided so far back. The globe now comes freely outside the orbit, and, when the obliques are cut, is free.

There is seldom any serious bleeding; a plug of gauze may be placed inside the lids, and a pad and bandage over all. Often the plug is unnecessary.

The after-treatment is simple; the plug, if one has been inserted, is removed after forty-eight hours, and the socket gently washed out. Secondary hæmorrhage is almost unknown, and the plug never, in the writers' experience, need be re-introduced. The socket should be washed out three or four times daily; the patient may be allowed up on the third day, and will almost certainly be able to go out of hospital within the week. It is well to defer the wearing of an artificial eye for about a month. For the first fortnight a mild astringent lotion should be used several times a day.

In some cases, after the globe has been removed, the surgeon will find that he has not cut the optic nerve as far back as he wished. It is then easy to feel the end of the nerve among the orbital fat as a thick rounded cord. This may be caught in forceps, pulled forward, and redivided with the scissors.

To make the primary division easier and more certain, Dr Henri Joseph has devised a hook-neurotome, on the principle of the tonsil guillotine, by the aid of which it is possible to divide the nerve with certainty, within a very few millimetres of the apex of the orbit.

Occasionally, when there is a large wound of the globe, and it is collapsed, it is a little difficult to remove by this method. For such cases Freeland Fergus (48) describes a method of enucleation which he recommends as very rapid, and needing a very simple armament.

Standing on the side of the eye to be removed, he lays bare the tendon of the external rectus muscle; he passes one

blade of the straight scissors under this and divides it near the globe; then, seizing the cut insertion of the tendon, he rotates the globe inwards and divides the optic nerve, and, rotating still further, he divides the other muscles as they come into view close to the globe. He claims that he is able to deal with collapsed globes more easily by this than by any other method.

Enucleation is an operation which has many points in its favour; it is easy of performance, almost without risk, requires few instruments, and little time for recovery. Patients can often leave the hospital within a week from their admission.

It may seem something of a surprise at first sight that this operation, which opens freely a serous space continuous with the meningeal cavity, is rarely associated with meningitis; and, further, that this complication, if it occur, seems to be due to infection through the orbital roof, and not to extension along the nerve-sheaths. The two factors that account for this freedom are probably, in the first place, the open drainage; and secondly, the direction of the lymph current, which is from the skull forward along the optic sheaths.

There is, however, little doubt that, if the eye is in a state of active suppuration, there is a slight risk attendant on enucleation, and for this reason some of the other operations have been suggested.

But, generally speaking, the disadvantages of enucleation are concerned with the after conditions, and the gravest failure is the marked deformity which ensues, and is only with difficulty hidden.

The fat and muscles remaining after the removal of the eye fall together in the orbit and form a concave stump, against which the artificial eye is placed. The upper lid is imperfectly supported, and falls back into the orbit, leaving a deep hollow below the brow. Since the stump is ill-formed, its movements are themselves imperfect, and the transmitted movements of the artificial eye are still less.

The vacant, staring look is very noticeable, so that many people prefer the frank deformity of an enucleated eye. And this, though the chief, is not the only, fault to be found with the operation. The prosthesis is concave, and between it and the concave stump a large space is left, in which secretion accumulates, and, decomposing, irritates the conjunctiva, giving rise to chronic conjunctivitis.

The discharge then, in turn, roughens the surface of the eye and rapidly destroys its polish, until it is unfit for wear.

Lastly, the perpetual irritation gives rise to chronic inflammatory changes in the sub-conjunctival tissue and the underlying capsule of Tenon, so that bands are formed which, cicatrising, make the culs-de-sac shallow and render the retention of an artificial eye difficult, and sometimes impossible.

The disadvantages can be lessened in some degree by care at the time of operation, or even afterwards.

At the time of operation it is most important that all conjunctiva shall be preserved—as little as possible must be removed with the eye. Its relations to Tenon's capsule should be respected, so that there shall be little formation of bands.

The stump can be kept more prominent by preventing the slipping back of the external ocular muscles; these may be held forward by sutures.

In the first operations of enucleation, no sutures were placed in the conjunctiva, which was allowed to fall over the gap left after removal of the globe. Later the edges of the cut conjunctiva were brought together, and the wound closed so as to encourage rapid union.

Still later various surgeons devised plans of uniting the tendons and Tenon's capsule to the conjunctiva.

The closing of the wound necessarily draws on the conjunctiva of the fornices, and makes these shallower. There are three possible directions of suturing: the line of closure may be vertical (this will draw on the lateral fornices); it may be horizontal, drawing on the upper and lower fornices; or the conjunctiva may be drawn together by a purse-string

suture, which will draw on the conjunctiva in all directions.

It is clear that the purse-string makes more demands on the conjunctiva than either of the other methods. We have already pointed out the importance of keeping the fornices as deep as possible.

The vertical and horizontal closures make less demands on the conjunctiva; is there anything to choose between the two? Generally speaking, there is more conjunctiva to spare in the upper and lower fornices than in the lateral; further, the lateral movements of the eye are more visible than the vertical. It is a pity, therefore, to draw on the lateral conjunctiva and limit the movements of the artificial eye.

On the other hand, the vertical line of closure is much better supported by the lids during healing, and this is of weight when any graft has been placed in Tenon's capsule.

It is very desirable, we repeat, that the muscles and Tenon's capsule should be contained in the sutures; they should not merely draw conjunctiva over the wound.

De Wecker seems to have been the first to suggest this plan (49); he employed a purse-string suture. Snell (1) suggested passing a suture through each muscle and the overlying conjunctiva and tying them in pairs; Clarke at the same time (2), described a method by which he attached the lateral recti only to the capsule and conjunctiva, the inner to the upper lip of the wound rather outside the middle, and the outer to the lower lip towards the inner end. The wound was closed in a horizontal line.

Most surgeons who employ this manœuvre use a purse-string, and disregard the fact that it makes an unnecessarily large call on the conjunctiva.

It is best to pass the suture before the muscles are divided; it adds considerably to the difficulty to allow them to retract into the orbit, and then have to search for each and draw it forwards to pass a suture through it.

Todd (3) gives the following simple method :

First Stage.—The conjunctiva is divided all round the cornea in the usual way.

Second Stage.—The surgeon picks up the tendon of the rectus superior on the squint hook, and passes a curved needle armed with a long suture through the conjunctiva over it; pulling the retracted conjunctiva forward, he makes the needle perforate the capsule and the tendon, and then return through the tendon capsule and conjunctiva to the surface. Lastly, he divides the tendon. All four tendons are dealt with in the same way with the same suture. After the globe has been removed—and a little care is needed to avoid division of the suture—the conjunctiva and tendons are drawn into a firm stump by tying the ends of the single suture.

When a simple enucleation has been performed, the practitioner may be asked to remedy the resulting deformity; three methods then are open to him. He may attempt to improve the existing stump by dissecting up a pocket of tissue and inserting a glass sphere. This is not likely to be successful in greatly improving the movement, though it may improve appearances.

Suker's Method

Suker (4) advocates the use of paraffin injections for a similar object.

The parts must be well cocainised and the bleeding prevented by free use of adrenalin.

Instruments.—Fixation forceps, speculum, narrow scalpel, syringe for injecting paraffin, needle and needle-holder.

First Stage.—The surgeon seizes with the forceps the apex of the socket and draws it forward. Then he plunges the point of the knife into the tissues at this point for a distance of about 3 mm., and at this depth makes a fairly large pocket by sweeping the knife round in a circle, keeping the anterior

wall of the pocket about 3 mm. thick, and not enlarging the external puncture.

Second Stage.—He then passes a suture across the opening and injects the paraffin, filling the cavity but not distending it. Lastly the suture is tied.

Considerable reaction follows the operation, and if the quantity of paraffin has been too large, the anterior wall of the pocket may give way and the mass will be extruded.

An almost similar effect is gained by using the thick artificial eye known as Snellen's. This fits the stump better, and makes the upper lid more prominent.

Lastly, by wearing a convex glass in front of the glass eye the sinking in is partly hidden.

None of these devices is entirely satisfactory, and none of them affects the shallowing of the fornices. As has already been stated, it will sometimes be found that sockets, many years after enucleation, become so shallow by the growth of bands that no glass eye can be worn. This is a great disadvantage to people who are at all dependent on their appearance for employment; it is then necessary to try to remedy the defect by operative procedure. If the socket is merely obstructed by a single band, it is often possible to divide it, and by the immediate use of the glass eye, to prevent, for a time at least, its reappearance. Sometimes, however, the whole cul-de-sac is shallowed, and this is a more serious matter. The lower cul-de-sac is that usually at fault. Many operations have been suggested for the relief of this condition.

It is sometimes possible to correct the defect by a simple proceeding, and it may always be tried first, since it is not likely to do harm. This is to pass the needles of a doubly armed suture, from the lower cul-de-sac, down to emerge on the cheek, or even in the groove between the cheek and the gum. There remains a loop of silk, pulling down the fornix, and the good effect may be permanent. The only harm that can follow is suppuration along the track of the needles. If this fails, some

plastic operation must be performed. Maxwell (5) has recently described a method which is at once simple and apparently effective.

Maxwell's Operation

Instruments.—Scalpel, dissecting forceps, pressure forceps, glass mask, needles and needle-holder.

First Stage.—An incision is made at the bottom of the shallow cul-de-sac in its whole length, some 5 or 6 mm. deep. It is made the same depth along all its extent (*a b* in the diagram).

Second Stage.—On the skin of the lid are made two incisions, one about one-sixth of an inch below the lid-margin and the other curved below this, enclosing between them a semilunar area of skin about 12 mm. broad in the widest part. The length of this curved incision (*c d* in the diagram) must be greater than that of the first. The crescent of skin thus marked out is going to form the lining of the new cul-de-sac.

Third Stage.—The upper limiting incision of the crescent is deepened until it joins the incision in the cul-de-sac. The margin of the lower lid now forms a bridge attached only by its two extremities.

Fourth Stage.—The crescent of skin is dissected up from its borders until only a relatively small part (about one-sixth of the whole) near the centre remains attached to the subjacent tissues. This is represented as unshaded in the diagram.

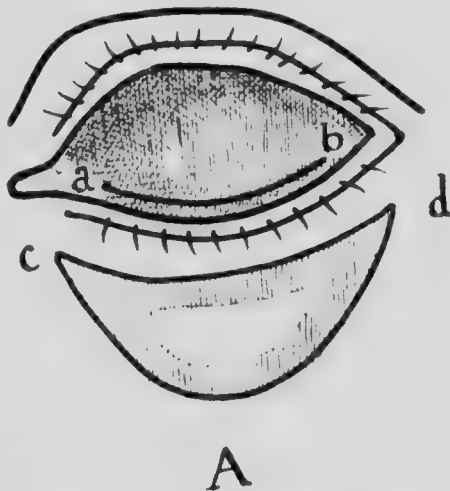


FIG. 31.—Maxwell's operation. End of fourth stage.

Fifth Stage.—The bridge of skin bearing the lashes is held forwards, and the crescent slipped under. The two extremities are secured into the angles of the first incision, and to its posterior lip the upper border of the crescent is fastened by two or three sutures.

Then the lower border of the crescent is brought up and stitched to the conjunctival edge of the bridge. The crescent is thus doubled on itself, and forms a groove, the posterior wall

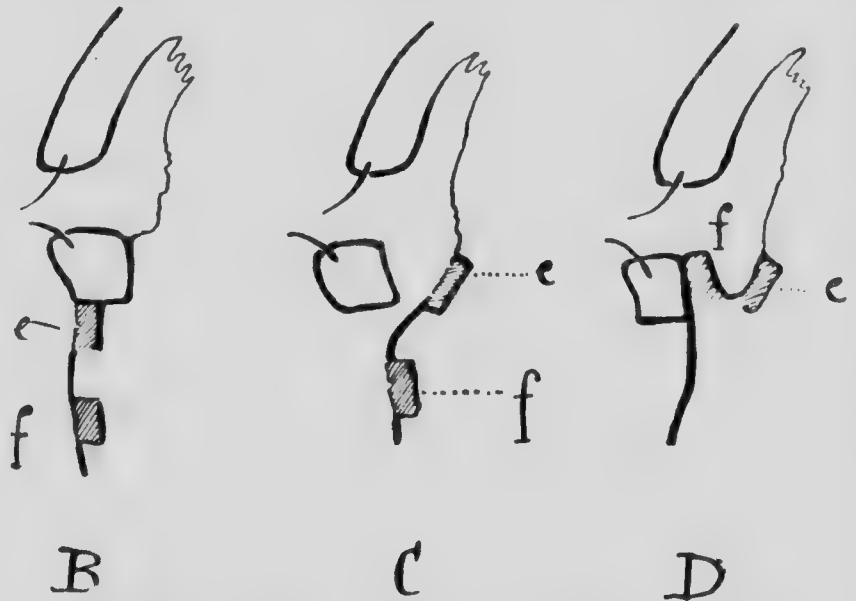


FIG. 92.—Maxwell's operation. Diagrams to show formation of new cul-de-sac. In each the parts *e* *f* represent the upper and lower parts of the crescent flap.

of which is formed by the upper, the anterior by the lower half of crescent.

The undissected pedicle holds the floor of the groove down.

Sixth Stage.—It remains to close the wound on the surface of the lid, and this must be done carefully or there will be a troublesome scar. The two edges are very disproportionate in size; the lower is much longer than the other.

The first step towards closing the wound must be a stitch in the centre of both edges, then one on each side midway between

the centre and the extremities. The coaptation of these two edges is the most difficult part of the operation.

This completes the whole procedure, but, before the pad and bandage are applied, a glass mask, preferably with a central opening, must be placed within the lids to depress the newly formed cul-de-sac until healing is advanced. It should be left in for a week or ten days; the central opening is an advantage, as it enables the socket to be washed out easily.

Cross's Operation

Cross (6) of Bristol has described an operation for the relief of a contracted socket, which is not difficult of performance.

Instruments.—Scalpel, dissecting forceps, pressure forceps, scissors, needles and needle-holder.

First Stage.—The surgeon makes an incision half an inch long outwards from the outer canthus dividing this.

Second Stage.—He then marks out and dissects up a flap of skin, extending down and outwards from the upper lid with a pedicle attached to this. (If the skin of the upper lid be redundant, a flap may be cut from this having the base attached to the outer side of the external canthus.)

Third Stage.—He then makes a horizontal incision across the conjunctiva of the contracted socket from side to side, extending deep into the submucous tissue. From this incision he dissects up the conjunctiva on either side as freely as possible, so as to form a flap adherent to each lid, and leaving a large raw surface in the floor of the socket.

Fourth Stage.—The flap of skin is then twisted on its pedicle and pushed into the orbit between the lids. Here the margins of the conjunctiva are stitched to its edges.

The stiff skin keeps the socket fairly deep.

The twisting of the skin flap and its compression between the lids is an unfortunate point of this operation, since the nutrition of the whole may be interfered with; a slight modification would avoid this. If, after division of the external

canthus, a vertical incision through both lids be made, and a flap cut as in Fricke's operation for ectropion, this flap could be readily passed in and secured without excessive twisting. A small secondary operation to divide the base and reform the outer canthus would be required a few days after.

It seems probable that all these operations will be abandoned in favour of the method of epithelial inlays, which was devised by Esser, and has given excellent results in the present war. As will be seen, it is similar in aim to the plan of treating symblepharon introduced by May, and described in the last chapter.

Esser's Operation (Epithelial Inlays)

For these operations very complete asepsis is required. For many of the operations ordinarily undertaken by the ophthalmic surgeon the use of rubber gloves for operating is unnecessary, as by no chance can his hands come into contact with the eye. In the present procedure, which is slow and tedious, and depends for its success on the strictest asepsis, gloves must be worn. The mould which is made of the cavity must be moulded and held by the fingers. If it is cut or held in forceps minute fragments of the dental composition may—almost certainly will—drop into the wound, and will give rise to trouble.

Instruments. — Scalpel, dissecting forceps, horn plate, needles, needle-holder, dental composition.

First Stage.—A curved incision is made through the skin the lid in the region of the shallow cul-de-sac, more or less parallel to the free border, and deepened until the surface of the conjunctiva is reached; care must be taken not to perforate this.

The margins of the incision are lifted and the tissues dissected as far as is necessary to form the new cul-de-sac. The scar tissue found here—the result of the injury—is dissected away as thoroughly as possible; the dissection must go close to the conjunctiva.

Second Stage.—A piece of dental composition is taken, softened in very hot water, and moulded roughly into shape to fit the cavity made by the dissection. It is altered by modelling with the fingers until it fits the cavity snugly, and allows the edges of the skin to be brought together easily over it. It is then taken out.

Third Stage.—A large Thiersch graft is cut from the inner side of the arm and wrapped round the mould, the epithelium being against the wax; the coated mould is placed in the cavity and the skin closed carefully over it.

In this situation it is left for some ten days; then an incision is made through the conjunctiva down on to the mould, and enlarged until the mould is withdrawn. A suitable prosthesis must be ready to place immediately in the cavity to retain the space gained. If this precaution is not taken the graft will shrink and the cavity will close.

It is clear that the nearer the inlay is to the conjunctiva the less tissue intervenes between the mould and the cul-de-sac, and the smaller the surface not covered by epithelium when the prosthesis is first put in. This emphasises the importance of carrying the dissection close to the conjunctiva.

Major Gillies tells us that he frequently makes the first incision through the conjunctiva instead of through the skin, and adds that the sole disadvantage of the route is the greater difficulty of clearing away the scar tissue.

OPERATIONS FOR THE RELIEF OF A HOPELESSLY DAMAGED EYE

GROUP 1.—Operations entailing the removal of no ocular tissue.

1. Tattooing.
2. Dianoux' method of cauterisation.
3. Optico-ciliary neurotomy or neurectomy.

GROUP 2.—Partial amputation (anterior amputation), with retention of most of the ocular contents.

1. Critchett's operation.

2. Lagrange's variation.
3. Chevallereau's operation.
4. Kenneth Scott's operation.
5. Attias' operation.

GROUP 3.—Evisceration. Removal of most of the contents of the eye.

(a) Without the insertion of an artificial vitreous.

- | | | |
|------------------------|---|--|
| Anterior
operations | { | <ol style="list-style-type: none"> 1. Noyes' operation. 2. von Graefe's operation. 3. Gifford's operation. 4. Ahlström's operation. 5. de Lapersonne's operation. |
|------------------------|---|--|

Posterior Operation.—Nicati's operation.

Combined Operation.—Ray's operation.

(b) With the insertion of an artificial vitreous.

1. Of inorganic matter ; Mules' operation. Modifications.
2. Of living tissue. Barraquer's operation.

GROUP 4.—Modifications of enucleation. Insertion into Tenon's capsule of—

1. Glass sphere. Frost's operation.
2. Melted paraffin. Ramsay's operation.
3. Rabbit's eye. Lagrange's orbital heteroplasty.
4. Graft of skin and subcutaneous fat. Rollet's operation.
5. Costal cartilage. Carlotti and Bailleul.

GROUP 5.—Removal of the globe with neighbouring tissues.

GROUP 1.—In this group no tissues of the globe are removed, but the eye itself is made use of and the need for an artificial eye avoided. The group contains operations of a very different nature, which have only in common these two factors.

The representatives chosen for description are :

1. Tattooing, combined, if needful, with tenotomy.
2. Dianoux' method of cauterisation.
3. Optico-ciliary neurotomy and neurectomy.

The substitutes for enucleation are various in their design. In some cases the surgeon is set to solve the problem, how to give the best cosmetic result to an eye which has lost all vision from ulceration, which has the cornea opaque and of approximately normal curvature, while the size of the globe is not diminished. In such patients it has been suggested that the surgeon may tattoo, in various coloured pigments, an imitation of the uninjured fellow, on the leucoma, in this way improving on the original suggestion of de Wecker, who was the first to advise the formation of a "pupil," in pigment, on the damaged eye.

Researches of various surgeons have resulted in the discovery of a number of pigments which can be used for the tattooing, without injury to the eye; they include black (lamp black), red (cinnabar), brown (a mixture of cinnabar, black earth of Sienna and Sepia), yellow (raw Sienna), blue (ultramarine or cobalt), grey (powdered graphite), and white (chinese white). (Holth.)

In preparing the pigments it is necessary to obtain them in a pure state as a very fine powder; this powder is sterilised by dry heat and mixed with a few drops of a sterilised solution of gum arabic immediately before use.

For the operation of tattooing, the surgeon requires a small corneal trephine, of about 5 mm. diameter, to mark the pupil, a larger of about 11 mm., to mark out the corneal margin, a scalpel, a sharp spoon and a bunch of needles, four fine needles surrounding one with a blunt end, so arranged as to prevent too deep perforation.

The method which Holth (7) recommends is as follows:—If the pupil alone is to be made, the surgeon marks out its limits with the small trephine, and with the sharp spoon removes all the contained epithelium. Then with the needles he punctures the stripped surface all over, and after this dips the points into the black and repeats the puncturing, until washing has no effect on the coloration.

When all the details of the iris and pupil are to be reproduced, he begins by marking out on the leucomatous surface a

ring with the large trephine, and tinting this with black. It is again necessary to remove the epithelium and then incise the tissue of the cornea radially with a knife. After this the pigment is pricked in with the bunch of needles.

Darier and de Wecker have suggested that when the eye is shrunken it may be made more prominent and the deformity concealed, by tenotomy of all the four lateral recti. Trousseau (8) recorded, in *La Clinique Ophtalmologique*, vol. xi., a case which was successfully dealt with by this method.

Dianoux (9) has suggested another procedure to replace, especially in children, excision of a bulging or staphylomatous eye.

There are many objections, surgical and sentimental, to the excision of a child's eye that can be saved at all. There is a good amount of evidence—not, perhaps, absolutely conclusive—that the bones of the orbit, and, indeed, the whole face on that side, fail in their proper development if the eye have been removed in early infancy. The thesis may be regarded as conclusively proved in the case of young animals other than human; the removal of the eye of an infant rabbit is always followed by imperfect growth of the sphenoid and malar, but the operation must be performed in the first months of life. When we come to the human eye there is no certainty; measurements on this point are few and unconvincing. But the general testimony shows, at the least, a marked prejudice against removal before the child has reached puberty. Probably, judging from analogy in the lower animals, it would suffice to put off interference until the fifth year, to guard against all risk of mal-development.

When the eye must be removed, enucleation produces marked deformity, which renders the unhappy child the butt of its companions' primitive humour; and this may do great moral damage to a sensitive child.

Dianoux' Method of Treating Anterior Staphyloma in Children

The object of this operation is to reduce the eye to about the normal size, leaving a stump on which the surgeon may afterwards tattoo an iris and pupil.

Instruments.—Speculum, fixation forceps, galvano- or other cautery.

A general anæsthetic, chloroform, is necessary.

First Stage.—The surgeon draws with the cautery, at a dull red, a star on the cornea; the rays vary in number directly with the area of the ectasia, and commence a little within the edge of the cornea.

At least 1 mm. of tissue must separate two adjacent rays.

The cautery is taken over and over the rays until at least two-thirds of the thickness of the cornea are burnt.

Second Stage.—Then he traces in the centre of the bulging area a small circle about 2 or 3 mm. in diameter, and gradually deepens it, finally perforating the centre with the cautery at a bright red, and allowing the aqueous to escape.

For dressing he sprinkles the eye with bismuth and puts on a compressive bandage, which he allows to remain untouched for three days; at the end of this time he changes the bandage morning and evening, but continues its use for several weeks, instilling at each dressing eserine and cocaine.

It is very important, says Dianoux, to avoid attempting to reduce the volume of the eye too much at the first operation; it is advisable to leave the stump too large, since contraction is continuous for at least three months after. If the ciliary processes have undergone atrophy as a result of the pressure to which they have been exposed, the globe will often shrink very much in after time.

The cases in whom the result is most doubtful are they whose enormous eyes have caused atrophy of the retro-ocular fat. When this has been absorbed, it is never renewed.

Tattooing will, later, much improve the appearance.

OPTICO-CILIARY NEUROTOMY

It is recorded by Von Graefe (10) that he had several times divided the optic nerve in cases of absolute glaucoma as a means of relieving pain without enucleation. The details of the procedure are not given, and the method was not taken up. Later, in 1876, Boucheron recommended the division of the optic and ciliary nerves as a substitute for enucleation in all instances where the larger operation might be necessary.

Boucheron's (11) Operation

Instruments.—Speculum, fixation forceps, strabismus scissors, squint hook, enucleation scissors, needles and needle-holder.

A general anæsthetic is necessary.

First Stage.—The surgeon makes a horizontal incision over the tendon of the rectus internus, and picks this up on the squint hook.

Second Stage.—He then passes two sutures through the tendon, first from the superficial surface to the deep, close to the cornea, and then from the deep to the superficial surface about 3 mm. nearer the muscle fibres. He then carefully divides the tendon in the interval.

Third Stage.—Now passing the large curved enucleation scissors into Tenon's space, he feels the optic nerve, and placing one blade on each side of it, he divides it at a single cut, together with the ciliary nerves, which enter the globe along-side of the second.

By pressing the points back towards the optic foramen, the optic nerve is cut long. There is pretty free hæmorrhage flowing on the division of the vessels at the posterior pole of the eye, and it is usually necessary to close the lids at this stage of the operation and apply firm pressure until the hæmorrhage is stopped.

Fourth Stage.—When this takes place the eye is again rotated outwards, the end of the nerve examined, and resected again

close to the globe, if the surgeon desires; then the tendon is secured by the sutures which were passed in the second stage, and the conjunctival wound closed also.

Firm pressure is required for some hours after the operation is finished.

It is not absolutely necessary to divide the tendon of the rectus internus; the optic nerve may be cut by passing the scissors into Tenon's space between the inferior and internal recti; it is not quite so easy, but it is still not difficult, to examine the posterior pole of the eye after this division. This, as a matter of fact, was Boucheron's first method.

The operation was originally recommended by Boucheron as a substitute for excision in those cases in which sympathetic ophthalmia was to be dreaded; the inventor relied on the theory of Deutschmann as to the mode of propagation of this disease, according to which it spreads along the optic nerves; it has been shown, by unfortunate clinical experience, that the protection given by this operation is inadequate, and in a certain number of cases sympathetic inflammation of the fellow eye has followed. The original scope for the procedure has therefore been much reduced, and if it be undertaken at all, it will be for such conditions as hæmorrhagic glaucoma, in which the eye is hopelessly lost as a visual organ and yet is exposed to severe attacks of pain.

The relief, in these cases, is usually complete, but the great effusion of blood which not infrequently follows, gives occasion to severe pain for many days in some patients.

Golowine (12) has described a more complicated plan, and in its course removes a considerable length of the optic nerve. He calls the method optico-ciliary neurectomy; it is in idea and performance very little different from the method of Boucheron.

The following are the chief differences:—

Golowine advocates the external route after division of the external rectus. He avoids hæmorrhage by clamping the optic nerve in pressure forceps and dividing it in front of the clamp.

This is allowed to remain fixed on the nerve for about ten minutes after it has been divided. This would seem to be a not unimportant point, since the exophthalmos from the hæmorrhage is, in the ordinary operation, often troublesome.

Lastly, he draws attention to the importance of searching carefully for the branch of the ciliary nerve which lies on the inner side beneath the internal rectus. This twig not uncommonly escapes when the optic nerve is divided, and unless the surgeon knows of its existence and looks for it, the whole operation may be a failure, since the pain for which the operation was undertaken may persist with little or no diminution so long as a single twig remains undivided.

GROUP 2.—In the second group some part of the ocular contents is removed, and the globe, lessened in size, serves as a support for an artificial eye. In the older methods the cornea was removed; in some of the more modern it is retained, though incised.

These procedures have been given up almost entirely in England, because they have been proved to be not without a real danger of sympathetic inflammation; they are still employed to some extent abroad.

AMPUTATION OF THE ANTERIOR SEGMENT OF THE GLOBE

The unsightly eyes which so often result from ophthalmia neonatorum have exercised the minds of many surgeons in an attempt to deal with them to the best advantage. When the whole globe is much enlarged, and the cornea protrudes, a hideous, shapeless mass, between the lids which cannot close over it, operation is needed, not only for the pain which is commonly suffered, but also for the removal of the deformity.

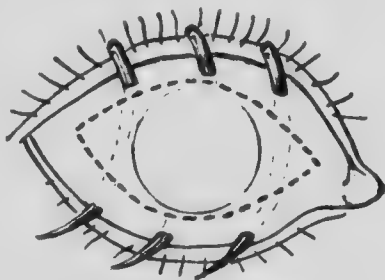
The objects of Critchett's (13) operation were to reduce the damaged eye "to a firm elastic bulb, that shall be fully influenced by the various muscles, and shall be about a third less in size, or, at any rate, in its antero-posterior measurement, than the normal eye, this condition being the most favourable for the employment of an artificial eye."

Several surgeons had attempted, before Critchett, the removal of an unsightly staphyloma, but they had not met with much success; in many cases the wound had not healed, or had eventually healed with a weak, yielding cicatrix. The first useful method was that which we are now about to describe, and from this circumstance all amputations of the anterior half of the eye are very often spoken of as Critchett's operations.

Critchett's Operation

Instruments.—Speculum, four or five needles and needle-holder, knife, scissors and dissecting forceps.

First Stage.—The needles are passed through the mass at about equal distances apart, just outside the lines of proposed incision. They are left *in situ*, with the points and eyes emerging.



Second Stage.—A small opening is made in the sclerotic in some part of the proposed incision, with the knife, and two incisions made with the scissors enclosing an elliptical piece, just within the extremities of the needles.

FIG. 93.—Critchett's operation. The parts within the dotted line are removed.

Third Stage.—The needles, with their sutures, are drawn through and the sutures are tied, bringing the edges of the sclerotic into apposition.

The advantages of passing the needles in this way are three: they relieve tension slightly, they serve to mark the lines of incision, and, lastly, serve to retain the vitreous which would otherwise escape.

In the hands of its inventor this operation gave very good results, and in favourable cases might yet be used without disadvantage. It has almost been given up in England, chiefly on account of the slight risk of sympathetic ophthalmia, but is

still not infrequently performed in France, where it has undergone modifications of various details at the hands of Aubaret, Picot, and Lagrange, among others. These are chiefly planned to increase the resistance of the tissue placed over the gap in the ocular capsule.

One of the latest modifications is that of Lagrange (14).

Lagrange's Operation

Instruments.—Speculum, fixation forceps, scissors, squint hook, Beer's knife, needles and needle-holder

It is convenient to have two needles threaded with rather stout silk of different colours.

First Stage.—The surgeon dissects up the conjunctiva all round the cornea for some distance, laying bare the insertion of the muscles.

Second Stage.—Then picking up each muscle on the squint hook in succession, he secures each with a silk thread. The superior and inferior recti should be secured with silk of a different colour from that used to the lateral tendons.

Third Stage.—After all the four tendons are held, each by a separate silk thread, the surgeon passes a purse-string suture round the mouth of the conjunctival opening.

Fourth Stage.—The next stage in the operation is the removal of the staphylomatous cornea and as much of the ciliary region as the surgeon thinks necessary. If the eye is at all irritable, and shows signs of old-standing cyclitis, it is better to remove all the ciliary zone. With this, of course, is removed the iris, the lens, and part of the vitreous.

Fifth Stage.—The purse-string suture then is tied loosely just with sufficient firmness to prevent further loss of vitreous, and the muscle sutures are tied in pairs, dragging the tendons forward under the conjunctiva over the open gap in the sclero-corneal capsule.

Then finally the purse-string is tied firmly, or if the surgeon mistrusts this form, replaced by interrupted sutures.

A very similar operation has been proposed recently by

Chevallereau (15), under the name of "combined transverse keratotomy." The object of this, as of all such procedures, is to give a stump which will be more prominent than that after a simple excision.

Chevallereau's Operation

Instruments.—Speculum, fixation forceps, Graefe's knife, iris forceps, cystitome and curette.

First Stage.—The surgeon makes an incision completely across the cornea in the transverse diameter.

Second Stage.—Passing the iris forceps into this large wound, he grasps the iris firmly and, with a twist, tears it from its attachment all round the circumference.

Third Stage.—He then tears the lens capsule with the cystitome, and removes the lens with the curette.

This completes the operation; the speculum is at once removed and a pressure bandage applied.

It is of importance, says Chevallereau, that the operation be performed rapidly; if the performance be leisurely, a large clot of blood will collect and prevent union of the flaps.

Kenneth Scott (50) published an account of a series of cases of staphyloma which he had treated by reducing the size and curvature of the cornea in various ways.

Attias (51) has revived one of these methods, and has given a full account of the details. By flattening the staphyloma, without entirely removing it, he obtains a large mobile stump, or an eye which is not uncomfortable nor very unsightly. His method is as follows:

Instruments.—Speculum, fixation forceps, Graefe's knife, De Wecker's scissors, fine forceps, needles, and needle-holder.

First Stage.—With a Graefe's knife he makes a puncture at the external border of the staphyloma, in the horizontal meridian, and carries the knife across to make a counter-puncture on the nasal side of the base. In this procedure the edge of the knife is turned forwards.

By saw-like movements he makes a horizontal incision between the puncture and counter-puncture. It is advisable, while making the incision, to guard against too rapid loss of the intra-ocular fluids.

Second Stage.—If necessary the lens and iris are removed.

Third Stage.—At this stage the sutures are inserted. The first needle, with very fine silk, is made to pierce the staphyloma in the infero-external quadrant, about 3 mm. from the

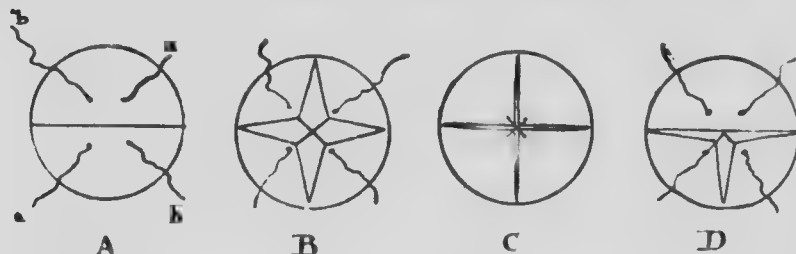


FIG. 94.—Attias' operation. A, B, C, on a complete staphyloma; D, on a partial staphyloma.

A shows primary transverse incision and sutures inserted.

B shows the extent of the excisions.

C shows the flaps brought together when the sutures are tied.

D shows the extent of the excision for a partial staphyloma.

limbus, and to issue at a corresponding point in the supero-internal quadrant. The second needle passes similarly from the infero-internal to the supero-external quadrant. The sutures are not tied.

Fourth Stage.—Then, holding the cornea in fine forceps, he cuts with the scissors narrow triangular sectors from the cornea in the form of a four-pointed star. This is most easily seen from the diagram.

Fifth Stage.—The sutures are now tied, bringing the flaps of the cornea together.

It is clear that the success of the operation depends on the correct judgment of the amount to be removed.

GROUP 3.—The chief feature of this group of operations is the removal of the ocular contents as completely as possible. A secondary division in the group is formed by those cases in

which a foreign body is placed in the empty sclerotic, to increase the size of the stump and with it the motility of the prothesis. Since Tenon's capsule and the conjunctiva are little interfered with, it is quite uncommon to find cicatricial bands appearing in the cul-de-sac at any period after evisceration.

(a) Without the insertion of an artificial vitreous.

- | | | |
|------------------------|---|--|
| Anterior
operations | { | <ol style="list-style-type: none"> 1. Noyes' operation. 2. von Graefe's operation. 3. Gifford's operation. 4. Ahlström's operation. 5. de Lapersonne's operation. |
|------------------------|---|--|

Posterior operation.—6. Nicati's operation.

(b) With insertion of an artificial vitreous.

1. Of glass. Mules' operation and modification.
2. Of living tissue. Barraquer's operation.

GROUP 3 (a).—

The first reference to evisceration is to be found in the account of the Fourth International Congress of Ophthalmologists.

Noyes (16) here stated that he was accustomed to deal with cases of suppurating wounds, and more especially panophthalmitis, by incising the cornea freely and wiping out the contents of the eye with a sponge until the sclerotic was left white and glistening. He thought that it would prove an efficient safeguard against sympathetic inflammation. Later, in 1884, von Graefe (17) revived the ~~idea~~ ^{idea} of avoiding enucleating eyes in a state of panophthalmitis. In some instances this had been followed by meningitis. His method differed from that of Noyes in that he excised the whole cornea and the surrounding sclerotic. The stump, therefore, was smaller than that left after Noyes' operation, but larger than that after enucleation.

Gifford (18) expresses himself strongly in favour of simple evisceration. What is usually called by that name is, as he points out, really evisceration with excision of the cornea. The removal of the cornea is, in his opinion, a needless mutilation,

and he advises all surgeons to leave it whenever possible; the retention of the cornea ensures a larger stump than that which follows the common operation, and gives no greater risk. He describes two methods of performance.

Any "simple evisceration" is often called Gifford's operation, even though the details may not be the same as those recommended by Gifford.

Gifford's Operation

(FIRST METHOD)

Instruments.—Speculum, straight strabismus scissors, fixation forceps, knife (scalpel or von Graefe's linear knife), sharp spoon, needles and needle-holder.

First Stage.—The surgeon makes an incision close to the cornea through the conjunctiva, extending from the middle of the insertion of the external rectus to the middle of the insertion of the superior. From the lower border of this incision he then makes a second running up- and backwards to the retrotarsal fold. The triangular flap of conjunctiva enclosed between these incisions is dissected up, so as to lay bare the sclerotic.

Second Stage.—He then makes, with the knife, an incision through the sclerotic, meridionally along one radius of the globe, between the two muscles whose tendons can be seen. This incision must be about 18 mm. long.

Third Stage.—Through this opening he removes the contents of the eye, making use of the sharp spoon, if it be required, to clear the ciliary body cleanly away.

Fourth Stage.—The conjunctival flap is then replaced and secured by a few points of suture.

(SECOND METHOD)

First Stage.—The surgeon makes an incision straight across the cornea from side to side and continues it into the sclera as far as he thinks necessary.

Second Stage.—Through this he empties the eye. No sutures are put in the cornea.

Gifford says that he was disappointed that the resulting stump was not always large enough to carry an artificial eye successfully. He therefore, in some cases, inserted one of Mules' globes into the empty sclera and secured it by suturing the cornea. This converts the operation into a modification of Mules', similar to that which one of us has described, and which will be found under that head.

In a later paper Gifford (52) describes how he has succeeded in keeping a large stump by pressing the front wall of the sclero-cornea back against the posterior wall "by means of a good-sized globular gauze swab dipped in sterile oxide of zinc ointment," which is left in place for forty-eight hours. The resulting stump is a large flat disc.

Ahlström, of Gothenburg, preserves the cornea in exenteration, in order to have the resulting stump as large and to keep the conjunctival sac as capacious as possible.

Ahlström's Operation

Instruments.—Beer's or von Graefe's knife, forceps, sharp spoon.

First Stage.—The surgeon makes with the knife a puncture about 1 mm. above the horizontal meridian and a little external to the sclero-corneal junction. He passes it across the anterior chamber to make a counter-puncture at the corresponding point on the opposite side; then he cuts downwards parallel with the plane of the corneal insertion and makes a flap equal to about three-fifths of the cornea.

Second Stage.—He then raises the flap out of the way by the forceps and scrapes out all the contents of the globe with the sharp spoon. Special care is needed to evacuate the choroid and ciliary body completely.

No sutures are put in, the interior of the eye is washed out by irrigation, and the corneal flap replaced in position. A pressure bandage is applied. This completes the procedure.

Ahlström claims for this method that the convalescence is shorter and the reaction less than that found when keratectomy is performed.

A variety of evisceration, "exenteration ignée," is strongly recommended by de Lapersonne (19) in cases of panophthalmitis, which, as we have already pointed out, are notoriously unfavourable for enucleation.

He incises the cornea freely in a cruciform manner, and then burns up the contents of the globe with Paquelin's cautery, holding the flaps of the cornea apart, and introducing the glowing point repeatedly into the vitreous and thus disinfecting by heat the tissues that are left.

SUBENUCLEATION

Nicati's Operation

Nicati (20), by his operation of subenucleation, attempts to preserve the anterior half of the sclero-corneal capsule while removing the posterior half and all the ocular contents.

Instruments.—Speculum, fixation forceps, scissors, sharp hook, needles and needle-holder.

First Stage.—The surgeon makes with the scissors a button hole through the conjunctiva over the insertion of the internal rectus.

Second Stage.—The tendon is held forward in forceps, and two sutures armed at each end with a needle are passed through it from its deep surface, one near the upper, one near the lower border, and onward through the overlying conjunctiva. The tendon is then divided between the sutures and the globe.

Third Stage.—From the incision the capsule is opened above and below the tendon, so as to allow the entrance of scissors, with which the optic nerve is divided as in enucleation.

Fourth Stage.—The surgeon now takes the sharp hook, and with it brings into sight the posterior pole of the globe which is stripped of the attachments of the obliques.

Fifth Stage.—He then divides the scleral coat all round behind the insertions of the recti, and removes the remainder

of the capsule and the whole content of the globe, paying special attention to the ciliary body and iris which are in connection with the anterior half.

Sixth Stage.—Lastly, he takes the needles on the deep ends of the sutures, which were passed during the second stage, through the tendon of the internal rectus, and passes them through the corresponding ends of the tendon and conjunctiva, which were left adherent to the globe. The ends are then tied, closing the wound in the conjunctiva and uniting the tendon.

Nicati states that the healing is more rapid than after simple enucleation, and that an excellent stump is left; the latter is probable, but the former is difficult to understand.

Ray (39) and Hall (40), as we have already mentioned, strive to make all safe by leaving only a ring of sclerotic, near the equator of the eye, with which the insertions of the muscles are preserved.

GROUP 3 (b).—

Mules' Operation

Mules (21), in 1884, dissatisfied with the cosmetic results of previous operations, proposed to place a hollow glass sphere in the empty sclerotic, and thus make a large prominent stump for the artificial eye. His method, which, with slight modifications only, remains the best cosmetic operation, will now be described.

Instruments.—Speculum, fixation forceps, cataract knife or scalpel, scissors, sharp spoon, artificial vitreous and introducer needles and needle-holder.

First Stage.—The surgeon with the knife cuts half round the cornea, and completes its removal with the scissors.

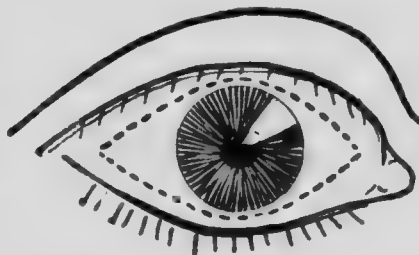


FIG. 95.—Mules' operation. The parts within the dotted line are removed.

Second Stage.—Through the gap thus left he removes the contents of the globe, being specially careful to remove the uveal tract as completely as possible. For this the sharp spoon is useful.

Third Stage.—The circular wound left by removing the cornea is not readily closed by sutures. So it is converted into an elongated ellipse, with the long diameter transverse, by the removal with scissors of two somewhat triangular portions, one on each side. All hæmorrhage should be stopped; it is most easily done by washing out with some hot antiseptic.

Fourth Stage.—A glass globe of suitable size is slipped by means of the introducer into the sclerotic, and the wound closed over it by sutures. (Mules advises that the sclera and conjunctiva should be united separately, but this seems unnecessary, and the sutures may include all the

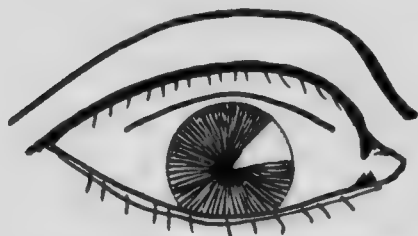


FIG. 96.—Modification of Mules' operation.
The line shows the incision.

tissues.) Three or four are usually sufficient. The surgeon must estimate what size of globe will be retained, and at the same time give a useful stump. Practically globes between 11 and 13 mm. are most useful.

The patient should be kept quiet during the first week or ten days of the convalescence, and the stitches should not be removed until at least ten days have elapsed, when the wound will be found soundly healed. A glass eye can be worn in a month.

In a certain number of cases the central stitch gives way and the globe emerges. Naturally the smaller the globe the less the number of failures and the less the reaction; but, on the other hand, the smaller the stump the less perfect the cosmetic result.

Although with the escape of the globe Mules' operation may be said to have failed, it may be possible to refresh the edges

and insert a smaller sphere. This has, in the writers' experience, rarely been successful. Even at the worst, however, the remaining stump is that of an evisceration, much more solid and more prominent to bear the artificial eye than that after complete excision.

It is clear that the reason of the special weakness of the central stitch is to be sought in the greater tension put on it, because of the imperfect adaptation between the shape of the inserted vitreous and that of the sclerotic after removal of the cornea.

It has been proposed by one of us to make this adaptation closer, by preserving the cornea, and making a long curved incision through the sclera above it. In this way, after the introduction of the globe the tension on the central stitch is less than that on the lateral, and, since the wound is entirely in vascular tissues, the healing is usually rapid.

It cannot be judged yet how far this modification is successful in ensuring union. So far the results have been very favourable. The only case of failure among nine successes was one where the operation was undertaken on account of a large contused and lacerated wound of the globe, which, having been with difficulty closed at the time of operation, eventually gave way, allowing the escape of the sphere.

Others have dealt with the difficulty in a different way, by making a long transverse incision across the cornea extending into the sclera. The disadvantage here is that the wound is in non-vascular tissue, and therefore heals with less rapidity.

The considerable number of cases in which the globe was extruded led Webster Fox (57) to search for the cause of this accident; he came to the conclusion that it was probably due to the irritation of the recti muscles. These pulled on the stitches, especially on the central stitch, until the globe was exposed. He therefore has adopted the plan of tenotomising all the four recti muscles immediately after the removal of the contents of the globe. After the stitches are

tied, he places within the lids a "conformer" shaped to the contour of the globe, which supports the wound and the stitches. He is satisfied that the operation has no real attendant risks, and regards it as suitable in all cases in which the eye would otherwise be removed, except in the presence of panophthalmitis—in which condition the operation never succeeds—and of intra-ocular neoplasm.

Webster Fox uses a 13 mm. or 14 mm. gold sphere.

Other substances—metal spheres, masses of sponge, etc.—have been proposed to replace the glass sphere of Mules, but so far without benefit.

Barraquer (22), at the Madrid Congress of 1903, proposed that the glass sphere of Mules might be replaced with advantage, by a mass of fat, cut according to his suggestion, from the gluteal region of the patient. This graft, being an organic living substance, would, he thought, heal into the empty sclerotic more kindly than a glass globe. The suggestion has been put into use by Troncoso as well as the originator, and the results are said to be very good.

Pflüger (23), of Berne, at the International Medical Congress at Paris in 1900, stated that theoretical reasoning had led him to use perforated globes in preference to complete spheres of glass; their value, in his mind, was that the granulation tissue took better hold on them. It has been our experience that a considerable number of the globes which were extruded from the eye were imperfect and showed a small hole, the interior being filled to some extent by fluid. This small hole has therefore seemed to us an unfavourable condition.

Lang uses gold spheres. Silver spheres have been used, but are objectionable as they give rise to argyrosis of conjunctiva and lids.

Gr 4 -The fourth group of the operations contains those procedures which are essentially modifications of simple excision, and have for their object an immediate improvement of the resulting stump. The modifications by sutures have been already dealt with. In the methods now to be described, some tissue

organic or inorganic, is placed in the empty capsule of Tenon, and makes the stump convex instead of concave.

The selected operations are—

1. Insertion of a glass sphere (Frost's method). Injection of paraffin (Ramsay).
2. Orbital heteroplasty.
3. Implantation of a graft of skin and subjacent fat (Rollet's operation).

Adams Frost's (24) Operation

Frost, in 1885, suggested that a glass globe should be put into Tenon's capsule after enucleation. The operation was done as follows:—

Instruments.—As for enucleation, with the addition of Mules' artificial vitreous and introducer.

Enucleation is performed in the usual way.

Then, without waiting to stop hemorrhage, the surgeon introduces a glass sphere about 13 mm. in diameter into Tenon's capsule and sews up the wound with three or four stitches. It is well, while the stitches are being passed, to grasp a large piece of both lips of the wound in forceps, and put the needles through the tissues at a distance of at least 4 mm. from the edge. Unless this be done the globe will probably escape during the healing. The stitches pass through conjunctiva and Tenon's capsule, and the central one probably also through the tendons of the vertical recti. The pressure of the globe soon stops all hemorrhage.

The reaction is less than that after Mules' operation, but more than that which follows enucleation. The length of convalescence and the cosmetic results are also intermediate.

Greenwood (53) is a strong supporter of Frost's operation. He does not approve of a purse-string suture of the conjunctiva; his method is to pick up each muscle as it is divided, and pass through it a suture, getting a good hold on the tendon. When the globe is removed he places a large globe in Tenon's capsule, using globes up to 22 or even 24 mm., and secures the capsule with a purse-string suture;

over this he secures the tendons, tying the superior to the inferior rectus, and the internal to the external by means of the sutures passed through them. Finally, he sews up the conjunctiva, making the line of union in the line of the palpebral fissure, so that there is least drag on the lateral conjunctiva, which is more scanty than that above and below the eye.

A variety of substances have been employed by surgeons in place of the glass spheres. Spratt (54) uses balls of hard paraffin, which offer several advantages: paraffin is non-irritating; it is cheap; it cannot be broken; and adapts itself to the shape of the retaining cavity. The balls can be readily made by the surgeon. Spratt uses three layers of sutures for the muscles, for Tenon's capsule, and the conjunctiva.

Ramsay's Operation.

Ramsay (25) has drawn attention to the good results which may be obtained by the injection of paraffin into the empty capsule of Tenon, after enucleation. Hertel (26) had published, a little time before, an article detailing the results of numerous experiments which he had carried out on rabbits, to see whether the orbit would bear the injection of paraffin, and thus give a better stump for an artificial eye than was obtainable by simple enucleation. His results on rabbits were entirely favourable: in some cases he injected hard paraffin, in others inserted a more or less globular mass after removing the eye.

Ramsay seems to have been the first to make use of the injections on the human subject. His method is as follows:—

First Stage.—The surgeon divides the conjunctiva as near the cornea as possible; then passing a squint hook under each rectus muscle in succession, he passes a strand of catgut, with a knot at one end, through the tendon and overlying conjunctiva. The knots prevent the catgut sutures running completely through the tendons.

Second Stage.—The tendons are then divided as close to the sclerotic as possible, and the eye excised as usual.

Third Stage.—The bleeding is now stopped by douching with hot sterilised water, and the capsule, stretched by the four strings, is stuffed with gauze moistened in a solution of adrenalin chloride. A strong purse-string suture is then passed all round the opening of the capsule.

Fourth Stage.—The gauze packing is now withdrawn, the nozzle of the special syringe inserted into the capsule, and the purse suture drawn tight round it. As much paraffin is injected as will distend the capsule, the syringe is withdrawn, and the suture pulled tight so as to prevent the escape of the injected paraffin, and tied. The four catgut sutures are then tied, the upper to the lower and one lateral to the other.

If a moderate amount only of paraffin have been injected, the reaction during the first days of healing is very slight. An artificial eye may be worn over the mass in about a month.

It is difficult to see that the procedure just described has any advantage over Frost's operation. It is said that the glass sphere is liable to fracture, but this risk is purely theoretical, and the injection of paraffin is certainly not devoid of its own special dangers. In other situations it has been followed by thrombosis of the neighbouring veins. During the formation of a new nose it has several times been the cause of blocking of the orbital veins on one side and total blindness of one eye. Certainly it is not likely that the injection of paraffin into the tissues of one orbit should give occasion to blindness of the other eye, but it is at least possible, and the risk more than counterbalances any objection to Frost's method.

ORBITAL HETEROPLASTY

Certain surgeons have tried to combine the safety of enucleation with the maximum of cosmetic effect by endeavouring to implant an excised eye from a rabbit into the capsule of Tenon, hoping that the graft would live and serve as an